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EDITORIAL

THE BBC'S PLANS for a series on personal computing, to be broadcast early next year, offer a great opportunity to inspire a wider public to appreciate the joys of personal computing. Yet as Martin Hayman points out on page 36, there has been considerable controversy about the BBC's choice of a computer for the project. It will be manufactured by the Cambridge company Acorn, which already manufactures the popular Atom computer.

Sinclair Research, another Cambridge company which produces the ZX-80 and ZX-81 computers, is so upset at not being chosen by the BBC that it has offered to produce a rival machine for less than half the price. Other companies seem just as unhappy.

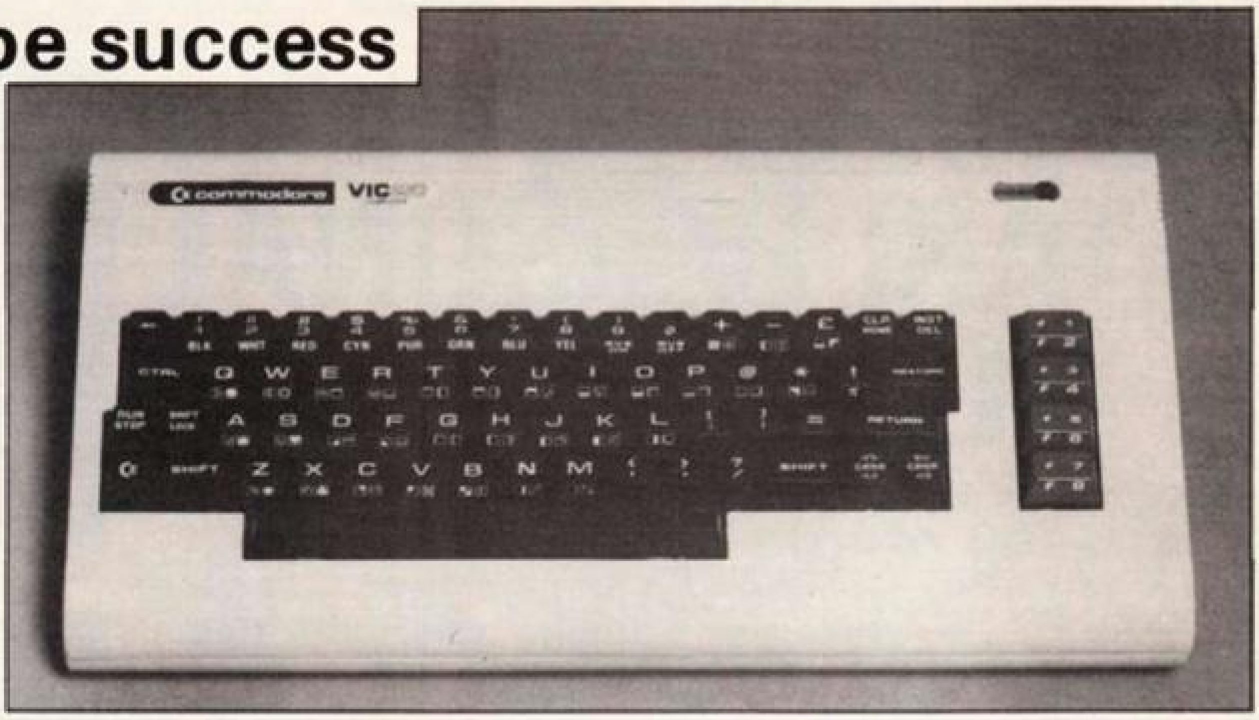
When planning the series, the BBC consulted a number of experts, presumably hoping to gather some sound advice about what would be the best computer for the project, the best programs to choose and the best way of putting it across on television. According to John Coll of Oundle School, "hundreds of them were involved". Is all the criticism sour grapes or has the BBC made a mistake?

In deciding to run a television series on computing which requires viewers to buy a BBC computer, the BBC is setting a strange precedent. The most famous director general of the BBC, Lord Reith, said that the role of the public broadcasting corporation was "to inform, educate and entertain". He never added "and manufacture".

In doing so, it could look as if the BBC is inadvertently using its great influence to upset the delicate balance of competition in the personal-computer industry — competition which has, in the space of three to four years, created an industry currently worth about £45million and likely to double in the next 12 months.

It is still possible that the BBC will be forced to change its plans. The cost of developing special software for the BBC computer may prove prohibitive. It may yet have to revert to using computer programs written in a standard form of the popular language Basic. ■

Vic set to be success



ONE OF THE most exciting events in personal computing this year is the official launch of a new computer from Commodore, the Vic-20. It is a full-colour computer which will sell for around £160. More details of the computer are given in the interview with Kit Spencer, Commodore's European marketing manager, on page 20. *Your Computer* features a full evaluation of the system in the next issue.

The launch of the Vic-20 has been imminent for some time — until Easter, Commodore was saying that it would be launched shortly after Easter. It now seems that the first public showing of the Vic in the U.K. is at the Commodore Pet Show, from June 18-20 at the West Centre Hotel in Lillie Road, London.

Despite the delays, the market seems to have accepted that the Vic will be one of the success stories in personal computing — primarily because it offers so much computing power at a low price and because Commodore has shown itself to be very adept at marketing.

The Vic-20 was launched in Japan last September where one department store reportedly sold 1,000 on the day of the launch. The Vic has since been selling at a rate of 10,000 a month — the kind of sales which were unheard of until Clive Sinclair launched the ZX-80 computer last year.

Commodore is already claiming that it will be able to sell 100,000 Vics in the U.K. by the end of the year by selling through High Street stores such as Currys — which already has a chain of computer stores — Dixons and other electrical chains.

The main worry about the future of the Vic is not whether it will be accepted as a winner by the market, but whether Commodore will be able to manufacture enough of them. It is a worry which Commodore executives have tried to play down but it has already meant the delay of the launch. Commodore hopes to supply 80 percent of the European market from its German production plant.

At the heart of the Vic is a new video-interface chip which has been designed and made by the Commodore U.S. subsidiary, MOS Technology. One of the limitations of the chip is that it allows only 23 characters per line on the television screen. MOS is now trying to overcome the problems by developing a new Vic which will allow 40 characters per line.

In the meantime, the Commodore team in the U.K. describes the limitation of 23 characters per line as a feature which makes the Vic suitable for schools: the characters are so large that a classroom of children will all be able to see what is on the screen.

Making yourself heard

VOICE synthesis is at last making its breakthrough into the home-computer market as the competition between the increasingly large number of voice chips forces down the prices. The latest product in this field for the personal computer enthusiast is called Speakeasy and can be plugged into the parallel output port of computers such as the Acorn Atom. Its voice sounds are controlled through software.

The voice output is controlled by phonemes; a phoneme is a voice pattern for an individual sound. For example "hallo" is made up of four phonemes; a "h" sound followed by "a", followed by an "l", followed by an "o". By the use of phonemes there is virtually no limit to the number of words reproduced.

The phonemes on Speakeasy are produced by an electronic model of the vocal tract. It does not, as some more realistic devices do, use pre-recorded digitised sounds.

Speakeasy is produced by Wide Band Products at Cambridge Road, Orwell, near Royston, Hertfordshire. 022020 8017.

Business payroll program for Sinclair

WHEN CLIVE Sinclair first launched the ZX-80, we realised that it would be a very popular introductory computer — a good way to discover if one enjoyed spending sleepless nights trying to work out why a program does not work. We did not realise, however, the extent to which the inventiveness of ZX-80 users would extend its range of applications beyond that of playing simple games and learning how to program.

Sinclair's early advertisements claimed that the ZX-80 could do almost anything from playing games at home to running a nuclear power station — it quickly withdrew the second boast. By now, though, it is no surprise to be able to report that someone has written a business payroll program for the ZX-81.

The program, which takes the full 16K of memory, is menu-driven and will use the new Sinclair printer when that is finally released. The program costs £24.95 and is sold by Syntax Software.

Another piece of software which has just been released for the ZX-80 is ZXbug, a machine-code debugging program. It is written in machine code and takes up about 1.5K of the valuable Sinclair memory. It enables you to search for a byte or word from any start address and will display in Hex code the address of the byte or word you are looking for.

It will also display the main and the auxiliary registers and you can alter them to any value required. You can copy any size of block memory from one address to another, modify bytes in memory and set break points in a machine-code program to help in debugging. Details from Artic Computing, 396 James Reckitt Avenue, Hull HU8 0JA.

If machine-code debugging is too much for you you can always challenge your ZX-80 to a game of chess with a new program needing 16K of memory. It costs £10 from P Joy of 130 Rush Green Road, Romford, Essex.

Schools teletext project

TEN SCHOOLS in England and Scotland have taken delivery of special Mullard intelligent TV sets as part of an experiment conducted by Brighton Polytechnic. The sets, which are TV, micro, teletext and Prestel receivers in one, will be used to assess the usefulness of new approaches to broadcast material for schools.

The scheme, which is being run by a three-man research team headed by computing lecturer Michael Raggett, in conjunction with Mullard in Southampton, the BBC and the IBA, will go beyond the traditional approach of computer-aided learning and attempt to use the machine in a more flexible way.

For example, the possibility of word-processing might well allow a more creative approach to the teaching of English language and literature.

The sets, which were specially developed by Mullard for the scheme and feature the new Lucy wonder-chip, will cost £1,000 each — Mullard has discounted all research costs — and the total cost of the project will amount to only £30,000 for the year it will run.

Among the objectives during that year is to discover to what extent any form of broadcast software will need to contain its own instructions. The obvious advantage of a self-document program is that it does not place too great a reliance on the computing skills of the teacher.

On the other hand, loading will be very much slower if all the instructions are broadcast with every program rather than held in ROM on-site. The latter option, though, would require printed documentation, which is an expensive disadvantage.

Government backs micros in education

SCHOOLS should benefit heavily from the Government's recently-awakened interest in micro-computing. Prime Minister Margaret Thatcher has decided that computing in schools is a good idea.

She has launched an Industry Department scheme to put a micro into every secondary school by the end of next year.

The Industry Department has ear-marked £4 million for this purpose, and it is known to favour the Research Machines 380-Z and the Acorn Proton — the BBC micro.

The increasing official backing for Acorn's product — both by Government and the BBC — has irritated rival manufacturers considerably. They have claimed, among other things, that Acorn is too ambitious, and that the machine and its associated software will not be ready in time.

First into the fray was Clive Sinclair whose firm, Sinclair Research, like Acorn, is based in Cambridge. Sinclair has maintained all along that he never had a proper opportunity to see the specifications for the BBC micro.

Tangerine has now followed Sinclair's lead and is going after Acorn with a free offer of its Microtan and the launch, later this year, of a machine which it claims will better the specification of the BBC Acorn micro.

Nascom bought by Lucas

THE SINGLE-BOARD microcomputer company Nascom has been bought by Lucas Logic, a computer arm of the well-known company Lucas Industries.

At the end of 1979, the most popular range of single-board computers was that made by Nascom. By the summer of last year, the company was in the hands of the receiver, Cork Gully, which has since been trying to sell the company while keeping it functioning as a going concern.

A large number of companies, and individuals, looked at Nascom's books with a view to buying the company. Almost all of them decided that all they would be buying was the name, since most of the original staff had either left or been made redundant.

There was a false start last autumn when it was announced that a company, Allteck Technology Initiatives, had taken over Nascom. This quickly petered out into legal wrangles. Since then, Nascom has been struggling to keep its name alive and also to make enough computers to meet the demand which still exists.

John Deane, general manager of Lucas Logic, told *Your Computer:* "We have taken a long hard look at the Nascom microcomputer and have been impressed by its technical qualities and broad general appeal". Production of the two Nascom computers will be moved to Warwick.

Although both the Nascom I and Nascom II computers still have a good deal of potential, Lucas has bought the company just as the new generation of computers is entering the market with more power for very low prices; the Commodore Vic-20, the Acorn Proton which is the BBC's choice of computer, the Tandy colour computer, to be launched in the autumn, the promised new computer from Sinclair Research, the promised new computer from Tangerine and the possibility of a new and low-cost computer from Apple early next year. In comparison with all of these, the Nascom computers are in danger of looking a little dated.

When Allteck was to buy the company, it was announced that Nascom would produce an inexpensive Prestel adaptor. It will be interesting to see whether these plans are revived or whether Lucas Logic, looking to its existing experience in industrial applications, will try and produce a new Nascom computer.

The new Hewlett-Packard HP-41CV calculator features five times the memory of the HP-41C and accommodates up to 2,000 program lines. It costs £169.35. There are more details in Fingertips on page 45.



Fastest Pascal compiler

AS IF TO prove that the Nascom computer should still be regarded as a serious contender in the personal computer market, a company called Hi-Soft has launched a Pascal compiler which, it claims, is the fastest available for an eight-bit computer. The package, on tape, sells for £35. Hi-Soft can be contacted at 60 Hallam Moor, Liden, Swindon.

Another product which will make the Nascom more attractive is a new music board which plugs directly into the Nascom PI/O and enables the computer to play musical notes over a range of eight octaves. The board is supplied with full documentation which gives constructional details and test procedures, programming notes and software examples.

The kit is priced at £8.95 and the assembled and tested version at £21.65. There is also a music-entry program with demonstration melodies at £7.50. BBF is at 82 Buckingham Drive, Luton, Bedfordshire. Luton 35930.

ZX-81 peripherals are already available

IT IS ONLY a few months, since Sinclair launched his new computer, the ZX-81 and already other companies are releasing accessories for it, although some of them have been adapted from last year's model, the ZX-80. One of the first is a keyboard sounder which bleeps every time you press one of the Sinclair keys. As you work your way through the five different functions which some of the keys allow, the bleep lets you know whether you hit the right spot and hard enough.

The KS-1 for the ZX-80 and the KS-2 for the ZX-81 cost £15 and £14 respectively, and can be fitted in a few minutes. The supplier, D Bruce Ltd, has also developed another version of the KS-2 which can fit inside the ZX-81 box rather than stand as a separate unit.

Some of the other products from the same company include a tape recorder interface for those ZX-80 users who have problems finding the best level for loading programs from their cassette recorders. The interface is a level shifter and raises the output of the cassette recorder from a few hundred millivolts to a 6volt square wave. The unit is self-contained, can be used with either computer and costs £10.

The final unit supplied by D Bruce converts the black-on-white TV output of the Sinclair computers to white-on-black which, it is claimed, is easier to read. These cost £10 and £20 respectively. D Bruce can be contacted on 0783 863612.



The KS-1 for the ZX-80.

Another company, JMJ Interfaces, has released a plug-in user port for the ZX-80 which should make it more suitable for use in schools. The port gives the user access to 16 input or output data lines and four lines for controlling such things as DC motors, mains appliances and other equipment.

The port is designed around the ZX-80 PI/O and is programmable in four modes. It also gives access to the positive and negative supply lines of the ZX-80 with a 24-pin DIL socket.

JMJ Interfaces is at Old School House, Rettendon Turnpike, Battles Bridge, Wickford, Essex.

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Do you belong to a computer club? Is there one in your area and if there is not, have you ever thought of starting one of your own? Good reasons for clubbing together include the pooling of resources, not least financial, the chance to meet other people who share your hobby and the reassurance that you are not alone in your struggle.

FORMING AND running a computer club is not as difficult as it may sound. If you happen to be a student, you have a head start. If the school or college already owns a computer, you are nearly there; if not, the mere act of forming a club may help speed up the appearance of cash from the school, parents or through the new Government scheme — see page 7.

If you are not a student and have difficulty in finding somewhere to meet, you may find that your local library rents its rooms at very reasonable rates.

In each issue of *Your Computer,* we will devote *Computer Club* to news and ideas emanating from the local clubs around the country.

We would very much like to hear how you are faring, about the formation of new clubs and see some of the programs you have written — we will reproduce the best ones. In particular, details of any project underway or about to start will be of interest: it does not matter if you are building an intelligent android to argue philosophy or you are writing a better *Othello* program — you can still use *Computer Club* to tell the rest of the country all about it.

Many of the popular small computers already have national clubs of their own but because membership of these is not always cheap, we would recommend that only one member of each club buys membership in the national club. Then all the benefits of membership of the large club can be passed to all and sundry — although do not expect them to thank you if you tell them that is what you plan to do.

If you think *Your Computer* can help you, send us a letter and we will give you what help and advice we can. If you would like a copy of our list of computer clubs in your area, let us know and we will forward you one. We pay £6 for each program or idea published.

To set the page going, here is a program written by Paul Kaufman of the Tangerine Users' Group, TUG. It is a computerised system for storing the names and addresses of club members, together with useful details like whether they have paid their subscriptions.

Membership list program in 5K

THIS IS a simple cassette-based club membership system for the Tangerine Micron. Having been involved in several clubs and user groups over the past few years, I have found that one of the most time-consuming and frustrating tasks is keeping track of all the members, their addresses, whether they paid their subscriptions, their club membership number and other relevant details. This program was developed to simplify this task and enable the user to dispense with card indices or scraps of paper with addresses written on them.

To use this program, at least 5K of RAM is required and access to, preferably, two cassette recorders. The program should run on most other systems with very slight modification. The changes needed are documented at the end.

After typing run, a menu is displayed, the program branches to a subroutine, depending on which option was selected.

- List of members: The user has the option of selecting one member or listing all members. Selection is by membership number. The program searches the tape until the end-of-file is read and then returns to the menu. If the requested membership number is found, the relevant data is read from the cassette and displayed on the screen. At this point, the more prosperous user could insert a jump-to-a-printer routine to dump from the screen.
- Add a member: This option is used to first create the file of members and then to append new members to the file. The program requests a membership number — between 1 and 1.70141*10E38. It is up to the user to devise a sensible membership numbering system. The name of the member and three lines of address are then entered followed by eight lines of comment. To prevent the program dropping back into command mode, a blank line, i.e., carriage return, should not be entered. An asterisk can be used to generate a blank line on retrieval of the file, the program takes care of it. The program will wait while the cassette recorder is started and then write the data. You have the option of closing the file or returning directly to the menu. To close the file, -999 is written. When new members are added to the file, the cassette should be positioned so that the new member data over-writes the end-of-file. A new end-of-file can be then written after the new member has been recorded. The end-of-file is easily recognised as it is the final "beep" on the tape.
- Delete a member: This is where the second cassette recorder plays its part. The file is copied from one recorder to the other — the members to be deleted are skipped. Up to 30 members may be deleted in any one run. The numbers of the members to be deleted are entered, followed by -1 and the recorders are started. It is advantageous if the remote-control option has been implemented as this saves several feet of tape.

Table 1. Cassette I/O options.

	Input	Print
LONG HEADER	POKE 22,1	POKE 22,255
SHORT HEADER	POKE 22,2	POKE 22,254

Although most of the program is straightforward, there are a few points that may help conversion to other systems. On line 50, POKE 14,1 sets the low baud rate for the cassette. Subroutine 20000 sets up a clear screen routine at Hex 1F40, decimal 8000. POKE 34,64 and POKE 35,31 set up the USR Function with the start address of the clear-screen routine and POKE 49,255 sets the maximum line width to 255.

In Tangerine Basic, there are no direct cassette data file handling commands. Cassette I/O is implemented by a POKE to location 22 followed by a PRINT or INPUT. This tells the Basic to dump or read into its I/O buffer. This makes program debugging very easy as the cassette I/O can be replaced by manual input. Table 1 sets out the various options that are used in the program.

For the sake of clarity, I recommend that the address and comments do not go over the edge of the screen. This program can satisfactorily handle up to about 200 members, above this number time becomes a constraining factor and a floppy disc is really necessary.

```
50    POKE 14,1 : GOSUB 20000 : POKE 34,64 : POKE 35,31 : POKE 49,255
80    DIM C$(7), DEL(30) : REM Arrays for comments and deletions
100   DUM = USR(DUM)
200   PRINT "** PUT YOUR CLUB NAME HERE**"
300   PRINT "**                          **"
350   FOR I = 1 TO 5 : PRINT : NEXT
370   FOR I = 1 TO 800 : NEXT : DUM = USR(DUM)
400   PRINT "Enter :" : PRINT : PRINT "1 = List of members":
      PRINT "2 = Add a member".
425   PRINT "3 = Delete a member" : PRINT "4 = End        ";
450   GET A : PRINT
500   ON A GOSUB 1000, 5000, 9000, 15000
600   PRINT "Undefined Option"
650   GOTO 370
1000  REM GET MEMBERS FROM TAPE
1100  DUM = USR(DUM)
1200  PRINT "Enter membership number"
1250  INPUT "If you want all, type -1" ; MEM
1300  POKE 22,1 : INPUT NUM
1350  IF NUM<0 THEN PRINT "End of file" : RETURN
1400  IF MEM>0 AND MEM<>NUM THEN PRINT "Member no.";
      NUM; "Found" : PRINT
1450  IF MEM<0 OR MEM = NUM THEN GOSUB 3000
1455  IF NUM<0 THEN RETURN
1460  IF MEM = NUM THEN RETURN
1480  GOTO 1300
3000  POKE 22,2
3020  INPUT NAME$
3100  PRINT "Member  :";NUM
3150  PRINT "Name    :";NAME$
```

(continued on next page)

(continued from previous page)

```
3180   PRINT "Address :";
3190   POKE 22,2 : INPUT ADDR$ : PRINT ADDR$
3200   FOR I = 1 TO 2
3250   POKE 22,2 : INPUT ADDR$
3280   PRINT TAB(8);ADDR$
3300   NEXT I
3400   PRINT "Comments      "
3500   FOR I = 0 TO 7
3600   POKE 22,2
3700   INPUT CMNT$ : IF CMNT$ = "*" THEN PRINT : GOTO 3820
3800   PRINT CMNT$
3820   NEXT I
3850   RETURN
5000   REM  Add a member
5100   DUM = USR(DUM)
5200   INPUT "Enter membership number";MEM
5300   INPUT "Members name.";NAME$
5400   PRINT "Enter address"
5450   INPUT "3 lines";A1$
5460   INPUT A2$
5470   INPUT A3$
5500   PRINT: PRINT "Eight lines of comment"
5550   PRINT "Enter '*' if blank line"
5600   FOR I = 0 TO 7 : INPUT C$(I):NEXT
5700   PRINT : PRINT "Position tape and start recorder"
5800   PRINT "PRESS SPACE WHEN READY." :GET X$
6000   REM  Create tape record
6100   POKE 22,255
6150   PRINT MEM
6200   POKE 22,254
6250   PRINT NAME$
6300   POKE 22,254 : PRINT A1$
6310   POKE 22,254 : PRINT A2$
6320   POKE 22,254 : PRINT A3$
6400   FOR I = 0 TO 7 : POKE 22,254 : PRINT C$(I):NEXT
6500   PRINT "Recording complete"
6550   PRINT "Do you wish to close the file."
6560   GET X$:PRINT : IF X$<>"Y" THEN 6700
6600   POKE 22,255 : PRINT -999
6650   PRINT "File Closed" : PRINT
6700   PRINT "STOP RECORDER" : PRINT : PRINT
6800   FORI=1 TO 700 : NEXT
6900   DUM = USR(DUM)
7000   RETURN
9000   REM Member Deletion
9100   DUM = USR(DUM)
9200   PRINT "Enter members to delete" : PRINT "Max 30, Type -1 to
       continue"
9300   FOR CNT = 1 TO 30
9400   INPUT "Member No. to delete";DEL(CNT)
9500   IF DEL (CNT) = -1 THEN 9600
9550   NEXT CNT
9600   PRINT : PRINT "Start playback recorder"
9700   PRINT "Start record recorder"
9800   PRINT : PRINT "PRESS SPACE BAR WHEN READY";: GET Z$ : PRINT
9850   PRINT
9900   POKE 22,1
9925   INPUT MEM
9940   IF MEM<0 THEN 12000
9950   FOR I = 1 TO CNT - 1
9960   IF MEM = DEL (I) THEN PRINT "Member"; MEM;"being deleted":
       GOTO 9900
9970   NEXT I
10000  PRINT "Member";MEM;" being transferred"
10100  POKE 22,255 : PRINT MEM
10200  FOR I = 1 TO 12
10300  POKE 22,2 : INPUT LINE$
10400  POKE 22,254 : PRINT LINE$
10500  GOTO 9900
12000  PRINT : PRINT "End of file read"
12100  POKE 22,255 : PRINT MEM
12200  PRINT "End of file written"
12300  PRINT "    STOP CASSETTE RECORDERS"
12400  FOR I = 1 TO 700 : NEXT
12500  RETURN
15000  DUM = USR(DUM)
15100  PRINT "        --+ THE END +--"
15150  FOR I = 1 TO 5 : PRINT : NEXT : FOR I = 1 TO 600 : NEXT : END
20000  FOR I = 8000 TO 8013 : READ Q : POKE I,Q : NEXT : RETURN
20100  DATA 169,32,162,0,157,0,2,157,0,3,232,208,247,96
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REVIEW

THE SINCLAIR ZX~81

Sinclair unveiled the ZX-81 in March, 12 months after the launch of the £100 ZX-80. The ZX-81 at £69.95 — £49.95 in kit form — represents another step forward in technology by Sinclair and offers a number of facilities which were unavailable on the ZX-80. How good is it? In this review, Tim Hartnell takes a close and critical look at the latest Sinclair computer.

MY CONCLUSIONS are clear — the ZX-81 is both a delight and a disappointment. Despite what I or any other reviewer says, Sinclair will sell 100,000 of them before Christmas.

Let us look at the disappointing side first. Late in December last year, 10 or so prototype new-ROM ZX-80s — old ROM-ZX80s with EPROMs — were loaned, on strict pledges of secrecy, to develop software for Sinclair to sell. I had one of the new-ROM machines, and was in regular contact with two others who also had them. Within days, it was obvious to me that something was very, very wrong.

The amount of the original on-board 1K left for program use after filling the screen with blanks for the Print At function — POKEing into the display file via the ROM — was so small that use of the 16K pack was mandatory for any worthwhile use. The 3K memory expansion board Sinclair sold for the ZX-80 will not work on the ZX-81 — unless you manage to cut connection 23B.

With the 16K pack fitted, the prototype new-ROM ZX-80s — and two of the three ZX-81s we have used — displayed an alarming lack of stability. At any time, the program would just vanish. Several times I was not even near the computer when it happened. Without warning, the program just vanished, leaving a blank screen. The ZX-81 then had to be unplugged from the power before it could be used again.

We rang Sinclair Research and pointed out that without data stability, there was no way the computer could ever be considered for serious use. I was asked to return the ZX-80 so they could check it. After a week, I had it back in exactly the same state and subsequent telephone calls assured me I was making much ado about nothing.

When I told Sinclair Research the nature of the review I would be writing for *Your Computer,* a man was sent with a new ZX-81 and 16K pack. While he was there, my ZX-81 refused to crash.

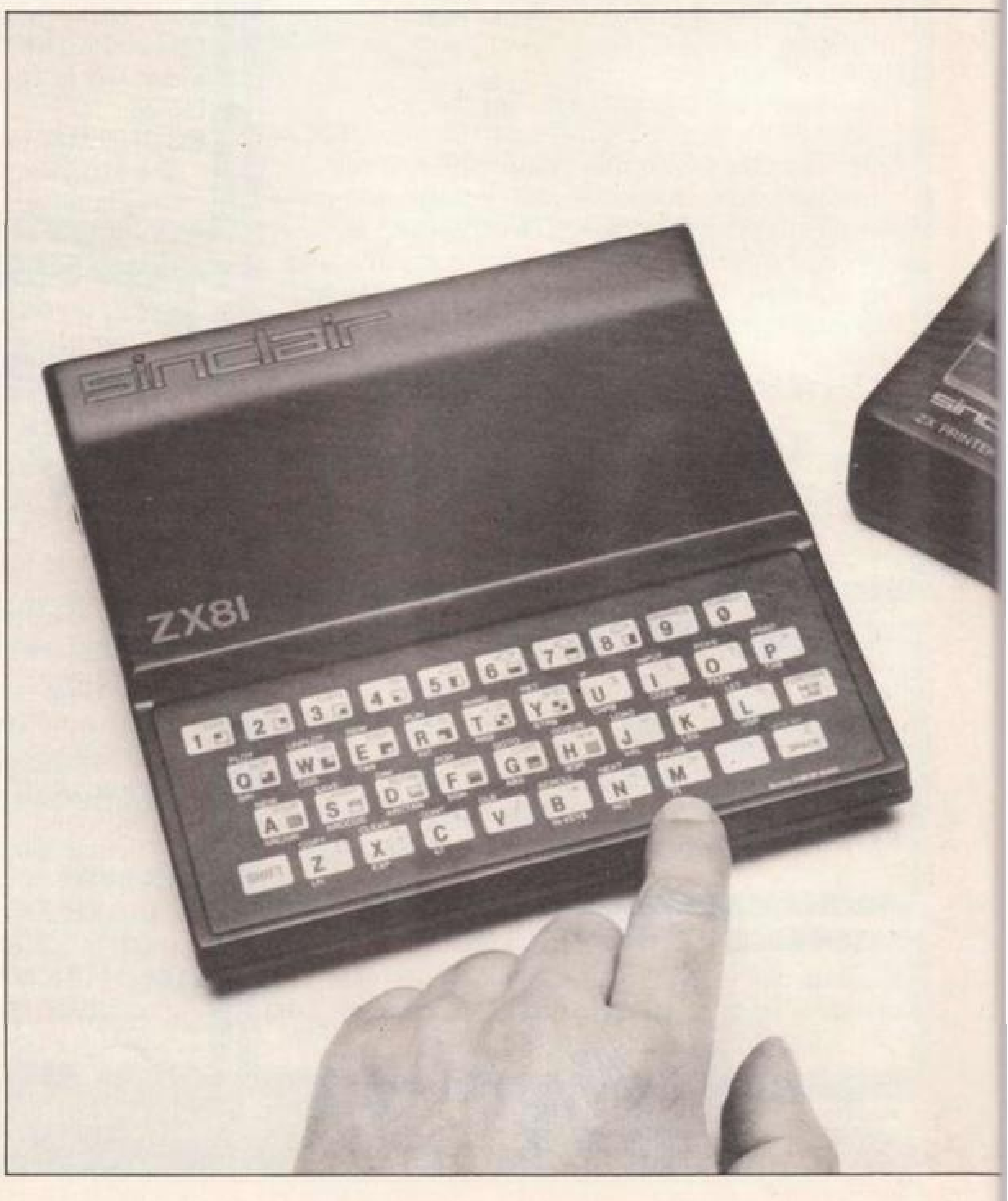
The ZX-81 you buy could perhaps be as unstable as the first two I tested. I could not test the third — it was constructed so you could not even plug the 16K pack in the back. The 16K pack seems to be at the heart of the instability problem. There seem to have been many problems with them — mostly of the "vanishing program" variety. The other strange behaviour they display is "the incredible shrinking RAM" when the available memory decreases to around 11K after a few hours' use.

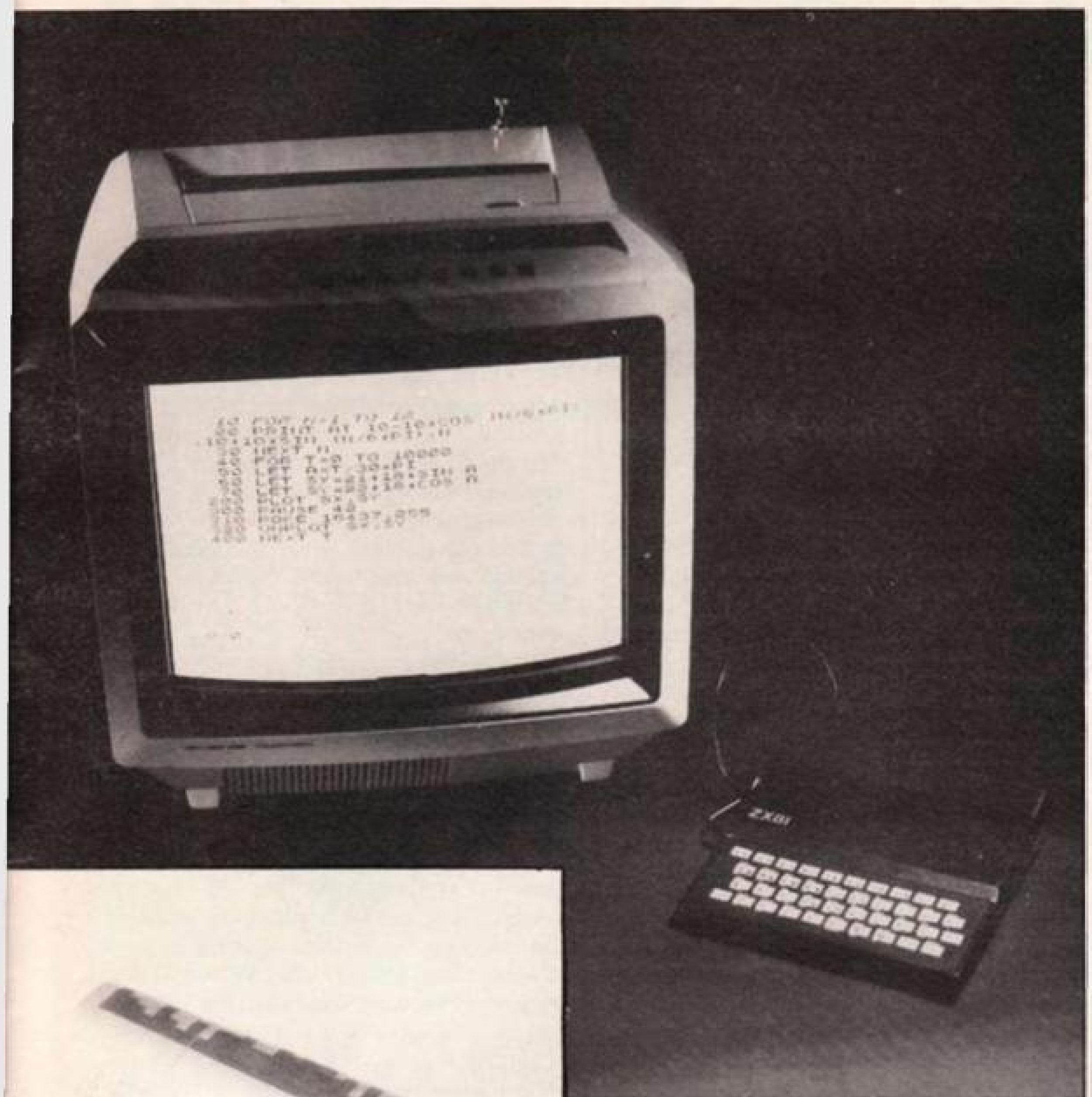
I have mentioned that, despite whatever was written about the ZX-81, Sinclair Research would sell 100,000 before Christmas. Let me explain why I think so.

It is undoubtedly a machine, albeit with display limitations, which will teach, in a very pleasant way, programming in a useful subset of Basic, which includes flexible string handling, a wide range of mathematical functions, and the use of additional commands like PEEK and POKE.

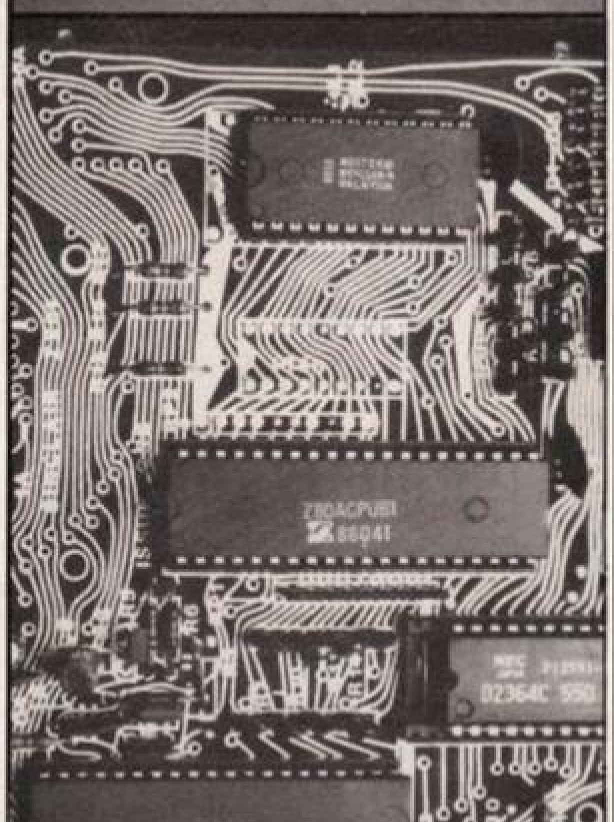
As well, there are the Sinclair-only delights of INKEY, Print At and Print To to master. There is no better way of getting to grips with computers and programming than to have one to play with — and the ZX-81 is the least costly way to gain hands-on experience.

The ZX-81 looks and feels good. It is about the size — 7in. by 7in. — and weight of a paper-back book, finished in matt black, with a matt-plastic keyboard finished in red and black. The power-supply, television and cassette in and out plug into the left-hand side.









Connection is simple, but you must be certain the plugs are inserted tightly, or the slightest movement of the computer will dislodge them.

There are many similarities to the ZX-80. Line numbers are from 1 to 9999; the first word after a line number or after the word Then — such as Let, Print, Goto or Gosub — is entered with a single key-stroke, and each line is checked for syntax errors before being accepted into the main body of the program. The touch-sensitive keyboard is simple to use.

The only feedback you have is when the characters appear on the screen. You will obtain numbers, key words — the word above the keys — if it is the first keystroke after a line number or letters by using the keyboard in the non-shift position.

Holding down shift — and you must be careful to press Shift exactly — gives you access to the commands written within the keys, such as Stop, LPrint and To. Holding down Shift and pressing Newline — the ZX equivalent of Return — while doing so will give you the functions written below each key. To obtain the graphics, you need to hold down Shift then press the Graphics key which is on the same little square as 9.

From then on, until you press Shift and Graphics together again, you will obtain the inverse of letters, numbers, the dollar sign and the like. You must depress Shift again, while in the Graphics mode, to obtain graphical characters like the grey square on the letter A keypad. This sounds a great deal more complicated then it is in practice, even though many keys can produce five different effects.

Despite the advertisements, the graphics are not high resolution. True, in the Plot mode, you use a grid of 64 by 42 as opposed to 32 by 21, but this is far from true high resolution. Here is a program to show the PLOT function.

```
10 FOR A = 2 TO 120
20 LET B = A*PI/30
30 PLOT A/2, SIN(B)*20 + 20
40 NEXT A
```

This routine plots a sine curve.

One of the most frequent sources of complaints on the ZX-80 was the flash which occurred every time a key was pressed, and the fact that the screen went blank when the computer was "thinking".

Sinclair minimised the cost of the ZX-80, in part, by using the same bit of computer to both think and handle the display — but it could not do both at once, so the display went blank during processing. A very important function on the ZX-81 — but which is not provided on the new ROM as it requires hardware to operate — is the Slow/Fast option.

Fast, which you trigger either by entering Fast, shift F, in the direct mode, then Newline before running, or by including a line like 10 Fast in the listing, makes the ZX-81 perform like a ZX-80. Processing takes priority over display, so what you see during thinking time is a grey, fuzzy screen.

The Slow mode, in which ZX-81 is automatic unless you input Fast, puts maintenance of the picture at a higher priority than processing. Although the ZX-81 runs about four times slower in Slow than it does in Fast, this is unlikely to bother a user in the vast majority of cases.

(continued on next page)

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The important thing is that the display is rock steady, without a hint of flicker, so animated displays of a kind can be produced. The display looks as if it is memory-mapped. The addition of Slow is, in my opinion, the most important development Sinclair has produced with the ZX-81.

Sinclair ZX-81 Basic allows only single statement lines, but judicious chaining with And, If and Then — lines may be up to 255 characters long — can simulate multiple statements, to some extent. The syntax-checking is superb. The computer refuses to accept an incorrect line which is better than computers which accept the line, then hang up when you try to Run it. It then puts an error marker next to the offending number or letter.

The Basic allows you to jump out of loops at will, with Goto or Gosub any syntactically-correct statement. So you can say

```
IF X = INT(2*PI/(T - B)) THEN GOSUB Y**T
```

or

```
IF J = 9 THEN PRINT AT B, SQR(B)
```

The Basic compensates for non-existent Goto and Gosub destinations by going to the next highest line — a useful feature for programmers who chop and change lines a good deal when working.

Although ZX-81 Basic has its own oddities, as do all Basics, it is a sufficiently standard version of Microsoft to enable a ZX-81 owner to adapt easily to Microsoft-using computers. There is no Read/Data function, but you can compensate in part for this lack by PEEKing and POKEing REM statements. The first address after the word REM in the first line of a ZX-81 program is 16514 — a fact you will not learn from the otherwise comprehensive manual.

String handling on the ZX-81 is a great improvement on the limited string functions available on the ZX-80. The very useful, if non-standard, ZX-80 function TL$, truncate left, which progressively stripped a string of its contents character by character, has been dropped by the ZX-81.

However, the ZX-81 offers string arrays. You dimension them as you do numeric arrays, by the statement DIM A$(9). Numeric arrays are dimensioned by using the letters A to Z in the form DIM A(9). Subscripts for string, character and numeric arrays start at 1.

DIM A$(9) will allow you to manipulate a single word of nine letters. If, for example, you set up the array DIM A$(9) and placed in the next line

```
LET A$ = "123456789"
```

and the following line was PRINT A$(7), the ZX-81 would output "7". If you entered

```
PRINT A$(2 + 4)
```

you would obtain "6".

```
PRINT A$(2 TO 5)
```

produces "2345",

```
LEN A$
```

gives "9" and

```
VAL A$
```

gives

```
1234567890.
```

The STR$ function — and note that all these functions are single-key entries — changes a number, e.g., 9, into a string, so

```
LET A$ = STR$(9)
```

sets A$ equal to "9". These functions are easy to use, but for some weird reason, the explanations are split up between two sections of the manual, 99 pages apart. You can also add strings, so

```
LET C$ = A$ + B$
```

is valid. You need to dimension the length of strings for proper string arrays, so

```
DIM A$(9,5)
```

will give you an array of nine words, each up to five characters long.

The manual is a great improvement over the much-criticised one provided with the ZX-80. For a start, it is comprehensive and covers all the functions available on the computer. It gives a proper list of system variables and addresses, has a brief chapter on machine code, includes a memory map and overall, does not make the assumption — which the ZX-80 manual did — that ZX-81 owners are unlikely to ever progress beyond the most straight-forward use of Basic.

The style of the manual is attractive, and is generally very friendly. It admits, where necessary, the limitations of ZX-81 Basic. The only real disappointment is that very few of the programs given in the manual actually do anything except illustrate a specific command. There are no games, even of the excruciating standard of the Nibble The Cheese variety given in the ZX-80 manual. So, even when you have worked through the manual, you still have practically nothing you can Run on the ZX-81.

Sinclair Research despatched the EPROM new-ROM ZX-80s to programmers to create a library of software to sell. There are four cassettes available; three games cassettes — two for 16K, one for 1K — and a "serious" pack containing Telephone, Note Pad and Bank Account.

Unfortunately, the instability of data within the ZX-81 means, in my opinion, that you would be unwise to enter information of value into the Telephone or Note Pad programs. The programs do little, except use a clever, extremely fast machine-code search routine, which you could not do with a piece of paper or card system. Bank Account is more attractive, but you would lose the state of your accounts if you could not Load the program at some stage.

The games programs are more interesting — and not just because I wrote a few of them. Cassette 4, for example, contains Lunar Landing, 6K, Twenty-One, 3K, Combat, 3K, Substrike, 2.5K, Codebreaker, 2K, and Mayday, 2K. They are good value indeed for £3.95, and although I could not Load them all — the Load reliability of the ZX-81 is much better than the ZX-80, but still far from perfect — the ones I ran made good use of both the mathematical abilities of the ZX-81, and the enhanced display using Slow. The 1K pack contains a superb Life, plus five other games.

Sinclair Research is working on a "computer learning laboratory" book and cassettes combination, as well as program packs suitable for teaching young children. As with the ZX-80, a whole cottage industry will arise to produce ZX-81 and new-ROM software. This time, however, the price structure will be dictated by Sinclair's very low price.

The printer was introduced in part to make the ZX-81 useful in computer-science courses which demand computer printout as part of their assessment program. It will have much wider use than this, and if the quality of the off-the-shelf printer is as good as the demonstration model I have seen, there is going to be a huge demand for it.

The printer works in a radical way. It is about the size of two cigarette boxes lying on their sides stacked on top of each other. A little ribbon flies around inside the printer base, with two needles protruding from the ribbon.

The needles "scan" the paper the same way a TV screen is scanned. When the printer meets a black dot on the TV screen, the needle darts forward and puts a similar dot on the 10cm. aluminised roll of paper. It takes about 12 seconds to print one screenful, and can either print the display — a screen at a time — or reproduce the entire listing.

The printer can be driven by both the ZX-80 with new-ROM, and the ZX-81. The commands LPrint and LList are just like Print and List, except they use the printer instead of the television screen. ■

The program to print a sine curve was reproduced, with permission, from Getting Acquainted With Your ZX-81, *published by Database Consultancy.*

CONCLUSIONS

- The apparent lack of stability, and the still-imperfect Load, seem the only real problems with the ZX-81.
  It is unfortunate that the 16K RAM pack was released apparently before being fully tested; it also seems unfortunate that Sinclair Research does not demand even more rigid quality testing before allowing ZX-81s on to the market. My first computer had a bubble in the keyboard overlay, and one of the three we used was so constructed that a 16K pack could not be added.
- The ZX-81 is a very good first computer and will open the world of computing to many who would be denied access to it by cost.
- It has a flexible Basic, and when the ZX-81 owner decides to upgrade — as many will in due course — he or she will find the language he has learned will stand him in good stead on his new machine.
- It seems a pity that Sinclair Research does not work to produce other than ephemeral computers: a simple machine, using Microsoft, with reliable Load/Save, a memory-mapped screen and a proper keyboard would sweep the market.
- If you have never used a computer, by all means buy a ZX-81. You will learn a good deal, have considerable fun, and when — in eight months or so — you are ready to move on to another machine, you will have enough knowledge to know exactly which computer to buy.

UK101-SUPERBOARD-TRS80 V. GENIE-MICROTAN-SHARP

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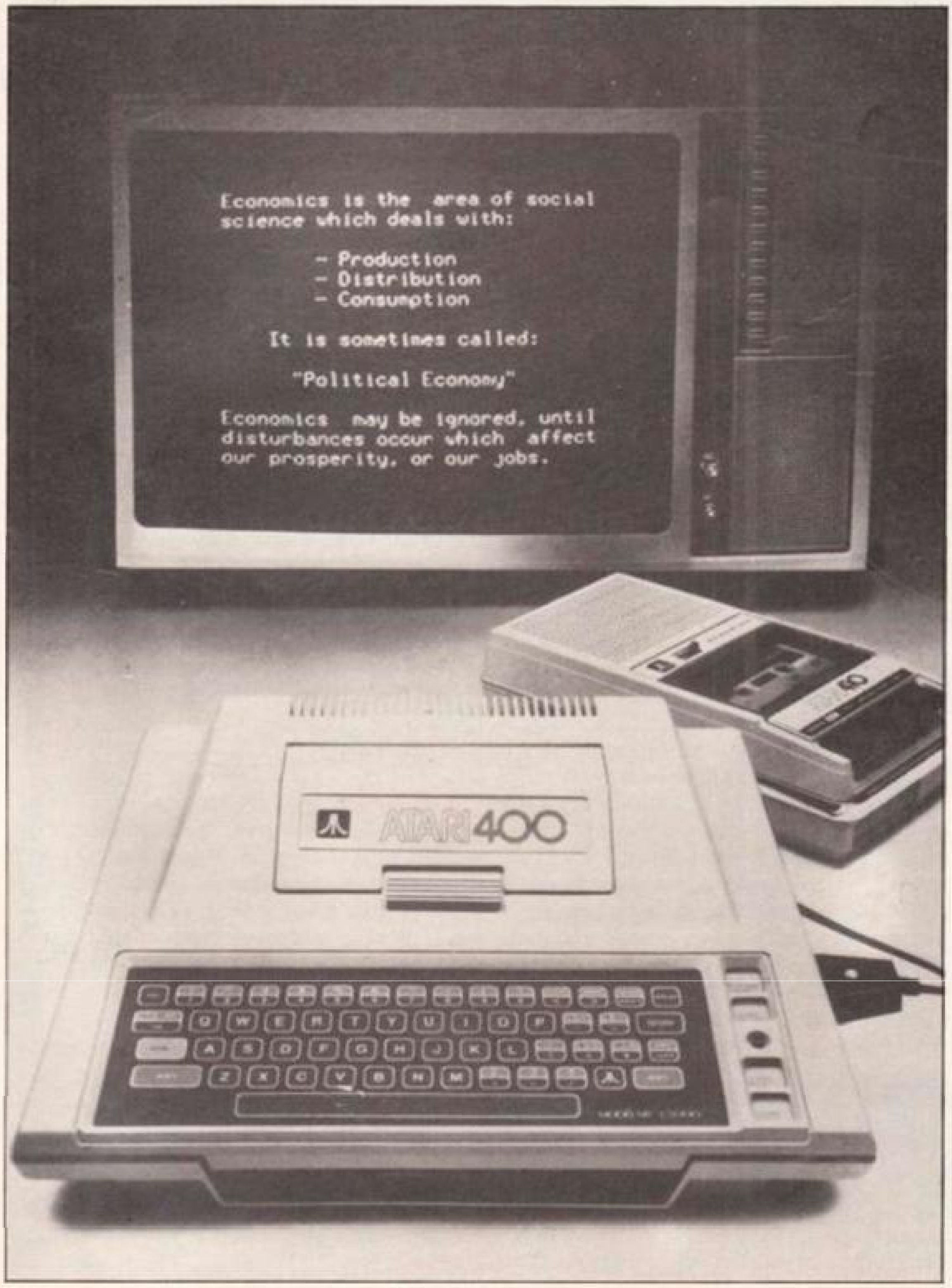
• Circle No. 112

Pleasure and business – the Atari

BY DAVID BANNISTER

The Atari 400 and 800 personal computers blend business with pleasure: they combine sophisticated game-playing facilities with the potential of a business computer. David Bannister looks at the tradition which produced these machines and assesses them from the hardware and software angles.

SEVERAL YEARS ago, computers were large boxes operated by highly-qualified staff in white coats. Today, you can buy a computer in the High Street. The general feeling among those who did not work with computers was that those who did were rather dull, but exceptionally clever with numbers. That, of course, was nonsense: some of them were dull, others had highly-developed senses of humour. Also, not all of them were all that clever, though some naturally were. It is those who were both clever and good-humoured who concern us.



When these fellows were not calculating the flight paths of lunar probes, they honed their programming techniques on devising assorted games for themselves. By today's standards, these were crude — since most of them printed out messages at a Teletype, there were no mobile graphics displays.

The main difference was that they did not work in real time. This is the jargon way of saying that the results of the actions of the player were given in separate batches, rather than as the continuous display we see on modern games. As the cost of electronics dropped and its speed increased, it became possible to add the now-familiar TV display.

Again, this was still not in real time usually, since the computer was being used most of the time for the serious purpose for which its owners had bought it and its attention was only rarely diverted to a game. This meant it was possible to make your spaceship burn some fuel and have to wait five or 10 minutes before a response appeared on the screen.

Nowadays, once the computer has decided what to tell you, it could tell you faster on the TV display than on the printer. I once waited half an hour during a game of *Star Trek*, only to be told that I had been destroyed by Klingon attacks.

Transforming factor

The factor that transformed computer games was the general availability of the microprocessor. Despite what people say about the chip, the good thing about microprocessors is that it means computing ability is inexpensive. Everybody can use them — in real time, too, which makes it easier to model reality. Video machines are just computers dedicated to one specific task.

Games today are still essentially the same as those which were being played — and still are — in computer installations 10 years ago, but the machines have improved and become much more widely available.

There are two types of videogame computer. There are those which play a selection of games — perhaps 10. Usually, they are tennis- and battle-type games. Although they were initially very expensive, manufacturing for today's mass market has led to a dramatic drop in price — just as it did with calculators.

The second type is the programmable game, which is still rather more expensive. By "programmable", we mean the kind of machine on which the user can write programs for himself. Television advertising suggests that some machines can be "programmed" by the insertion of assorted cartridges; these machines do not concern us here.

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The most obvious examples of these fully-programmable machines are the personal computers to be seen in most department stores or electrical shops. Most have the ability to do whatever the user tells them, with varying degrees of usefulness. What separates them into the market sectors to which each is sold is the software or programs available from manufacturers.

Some manufacturers choose to sell their machines as business tools and provide, say, accounting software, while others are sold as games machines — often accompanied by educational material. Certain technical factors contribute to which market a particular machine attracts — style is often important in this.

Economic reasons

A few machines have tried to make the transition to become a truly general-purpose computer. There are sound economic reasons for any manufacturer attempting to create such a machine — you have a bigger market and can sell more machines. It seems that when planning products, companies assume that every family conforms to the statistical norm and has 2.4 children, a certain income and Daddy makes all the decisions.

Part of the rationale behind making a computer which is both a videogames machine and a business machine is that the father can justify the expense of buying the kids a toy by using it as a serious computer. Having had an Atari 400 and an Atari 800 at home for some time, I can assure anyone thinking along those lines that they will be playing the games with the children — or rather, instead of the children.

Of the 10 or so people who visited my home while these machines were there, three were computer programmers, one was a dentist, two were doctors and none showed the slightest interest in anything other than one particular videogame called *Star Raiders*.

The major difference between the 400 and the 800, apart from price, is that the 400 has a touch-sensitive keyboard while the 800 has proper keys: the 400 also has a more limited memory size.

Supplied with the machines were two floppy-disc drives, a tape recorder — a floppy disc is much faster for the storage of programs — and a mountain of software. The machines have 48K of memory, which means that there is a good deal of capacity to hold software. Lifting a flap on top of the machine reveals a slot — two slots in the case of the 800 — into which program cartridges can be plugged. This is the third method of entering software into the Atari.

As far as game playing is concerned, the disc drive seems redundant since most of the games from Atari are on either tape or cartridge. The disc drives seem to be a concession to the notion of serious business use. Discs are very useful in most business applications: in effect, they are the systems filing cabinet.

In the case of the Atari system, I found them to be rather difficult to integrate into a program — which may have been my fault for attempting to use commands with which I was more familiar, but which the machine did not seem to recognise. In my defence, I would say that the manual for the drives is not helpful.

The tape drives are a joy. Loading a program from tape can be a tedious procedure, since it takes a considerable time for a program of any useful length. While loading, the Atari plays a soundtrack and a pleasant American voice gives useful instructions. My only complaint is that the tune is the same on each of the cassettes, and it becomes very irritating.

Having both the digital information of the program and an audio soundtrack is very useful for educational programs. One of the cassettes is a tutor in the Basic computer language, designed to enable anyone who has bought the machine to learn to program. This particular tutor is very impressive, since it can "talk you through".

In fact, most of the educational software supplied is of a better standard than I have often seen. For example, there is a geographical tutor which draws the states of the U.S.A. and asks you to name them, and their capitals. Because the map is drawn in colour, interest is sustained throughout. It also appealed to adults — I now know that the capital of Florida is not what I thought it was. The software, like the hardware, is very well finished. A great deal of thought has obviously gone into devising programs which would illicit the best response from the user.

Star Raiders, as the name implies, is a space game. In fact, it is a greatly-improved version of *Star Trek,* one of the original computer games. In full colour, with an amazing variety of noises, your starship travels throughout the galaxy destroying assorted aliens who fight back in a most realistic way. It is without doubt the best video or computer game I have seen, and the army of admirers who spent whole nights playing it in my front room will no doubt agree.

Videogame age

Which brings us on to the question: "Have videogames come of age"? I have to say that I do not think so. Although assorted technical factors have brought them — at least potentially — in to everyone's reach, there is something about the fact that they are visual games which makes me feel that they have to be made more realistic still.

Much is spoken about technology convergence, and with good reason. There are, however, few technologies which have not been integrated with games. When I can buy — or when I can afford to buy — a version of *Star Raiders* which uses holographic techniques and convinces me I am fighting in galactic space, then I shall say that videogames have come of age. ■

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Kit Spencer, who masterminded the Pet's penetration of the personal computer market in the U.K., has just taken up a new post as Commodore's European marketing director based in Switzerland. Before he left, he talked to Chris Hipwell about the personal computer phenomenon and about the Vic-20 — Commodore's bid to put a computer in every home.

INTERVIEW

KIT SPENCER

COMMODORE was formed 23 years ago in Canada by an entrepreneur called Jack Tramiel. It has progressed from its origins as a typewriter-repair business through the manufacture and marketing of add listers, electronic adding machines, calculators and electronic watches to its present position as number three in the U.S. and number one in the U.K. personal computer markets.

On this side of the Atlantic at least, Kit Spencer is identified with that development. He has just reached the end of a six-year stint with Commodore U.K. — the first three as marketing director of the consumer products division, responsible for calculators and watches, and the last three as general manager of the systems division.

Speaking in the Spartan surroundings of his office at Commodore's Slough, Berkshire, factory, Spencer is immediately recognisable as the youthful, somewhat intense figure who has become familiar through appearing in the company's advertisements.

Talking of a four-year period earlier in his career when he was marketing services manager with Pye in the colour TV and stereo field, he says: "I reached the conclusion that something was happening in the calculator field. I wrote a report predicting that the price of calculators would fall to less than £10 and that we were in at the beginning of a new industry".

That conviction took him to Bowmar Calculators where he was marketing manager before he made the move to Commodore in 1975. Now he is moving again but this time within the company, to take up a position as Commodore's European marketing director based in Switzerland.

This move occurs at a time when Commodore is poised to extend its customer base from the 45,000 or so business, educational and industrial users who have bought the Pet in the U.K., to a mass consumer market which could put computers in many thousands of homes over the next few years. The machine to take Commodore into this market is the Vic-20 — a full-colour personal computer priced at less than £200.

Vic — the initials stand for video interface computer — is, says Spencer, the product of development undertaken at three Commodore locations — MOS Technology, a subsidiary situated at Valley Forge in Pennsylvania; a Japanese subsidiary which has worked on colour TV and graphics and a development laboratory at Santa Clara, California which has been devising extensions to Pet systems.

"We pooled crude prototype ideas from these three locations," says Spencer, "and we put them together to offer a real and expandable computer at a price which would appeal to a wide market of personal and educational users".

The result is the Vic-20, a compact key-board-size computer which can be linked to an ordinary TV set to display output information and graphics. The processor, memory, input/output electronics and a chip which provides colour-display facilities are all accommodated in the keyboard unit. Additional memory in the form of plug-in cartridges slots into the back of the unit.



'People are becoming computer and keyboard literate'

Like the Pet, the Vic-20 is based on the Commodore 6502 microprocessor. It is also programmed in standard Pet Basic, so there is a reasonable measure of compatibility between the systems, subject to memory and display size limitations. The Vic has, for example, a 506-character — 22 characters by 23 lines — display which is not compatible with the Pet display and must be allowed for when transferring programs from one system to the other. Pet lines of more than 22 characters

OF COMMODORE

will "wrap round" not producing the same image on the Vic.

The Vic-20 also provides a smaller amount of RAM initially — 5Kbytes in the basic version — but this memory capacity can be expanded externally to 29Kbytes in a variety of RAM and ROM combinations starting with a 3Kbyte cartridge which contains space for additional ROM. The user can open the cartridge and enter ROM programs — effectively adding a ROM program on to a RAM memory expansion.

The use of plug-in memory cartridges makes for an extremely flexible system which is further enhanced by a series of features such as the ability to work with a colour TV set, a sound generator, a full-sized typewriter keyboard with programmable function keys. Other features include a Pet cassette interface, an RS232C interface for telecommunications and an IEEE interface which allows Pet peripherals such as a floppy-disc drive, printers and other devices to be connected to the system.

According to Kit Spencer, the Vic-20 is thus designed as a two-level product. A user with little computer knowledge can gain something from it immediately using the basic computer with a TV set as the output display to play a game or start a Basic programming course. On the other hand, the enhancement facilities such as the IEEE interface and the colour-graphics capability of the Vic mean it can be used for more sophisticated applications.

Spencer sees the market for the Vic-20 as reducible to three main groups: the hobbyist who is by definition a person with a technical interest in computing but who has, perhaps, not been able to afford a computer before; the educational field where the Vic will provide a low-cost but flexible system for school use; and the consumer field.

This last group, Spencer says, is rather different to the hobbyist category. It equates to the top end of the TV-game market and thus appeals to a far wider range of potential customers. "People are becoming computer and keyboard literate", he asserts. "The computer is becoming part of everyday life and parents can see that is where the future lies for their children".

This aspect of the personal computer phenomenon is regarded as particularly significant by Spencer and his colleagues at Commodore.



'The computer is becoming part of everyday life'

The Vic-20 is seen as a computer which will have an educational role in the home "giving your children a better future".

"There is an inherent demand for this type of system — there are all those who want a Pet and can't afford one and there is a growing awareness of computing, stimulated by TV games. Television is becoming interactive now and we have the right machine at the right price".

The commercial software which is being made available on plug-in ROM cartridges reflects this view of the market. The initial offerings include a programmers' series covering programmers' aids and a high-resolution graphics pack; an educational series covering such subjects as learning to program in Basic and learning to touch-type and an entertainment series including games such as the ubiquitous *Space Invaders*.

However, Spencer does not see Commodore as the only commercial source of Vic software: "In an expanding market, we would be arrogant to say we can do it all ourselves". Many software people want to write for Vic. "It guarantees that Vic will be well supported — the commercial entrepreneurs will see to that", he says.

The Vic-20 was launched in Japan, "the toughest electronics market in the world and the best place to prove a product", says Spencer. Initial response was impressive with more than 1,000 orders taken on the first day the computer was demonstrated in a Tokyo department store.

Japanese demand has taken up the initial production of 100 units a day and the production rate has been increased to more than 400 units a day to meet the expected demand as the computer is launched in the U.S. and European markets.

Within two months, it is planned to start production of the Vic-20 at Commodore's plant in Braunschweig, West Germany where Pet systems are already being produced. The possibility of establishing a chip-manufacturing plant in West Germany is also being considered.

Indeed, the company has high hopes for the Vic in Germany where, following its launch at the Hanover Fair, it is being promoted as a *Volkscomputer* — an obvious reference to that most enduring of marketing successes, the Volkswagen.

In the U.K., the Vic-20 will initially, at least, be handled by existing Commodore dealers. "Making sure that expertise and support is available is important — especially in the early stages", says Spencer. "Links with user groups and educational workshops are also beneficial in launching a new product".

There are already about 200 Commodore educational workshops throughout the U.K. These are schools or other institutions with three or more Pets which are prepared to open their doors to Pet users in return for public-domain software and technical support from Commodore.

This concept will certainly be extended to the Vic and in this way, the new Vic user will have access to centres providing information and technical expertise at locations throughout Britain. At the same time, the Pet newsletter will incorporate a Vic newsletter carrying hints on software and applications for the newcomer to computing.

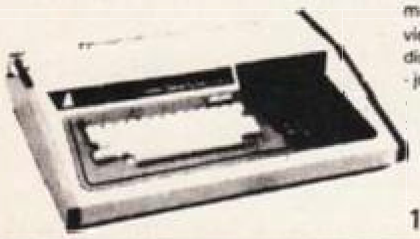
It is foreseen that demand for the Vic-20 could build up to such an extent by the autumn that further distribution arrangements will become necessary. Spencer admits that Currys has already shown considerable interest in the Vic-20 and it would not be surprising if Currys was to handle the computer through its Micro-C outlets.

In the next issue, *Your Computer* reports with a thorough technical evaluation of the Vic-20. ■



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RINGING THE ECONET CHANGES

BY BILL BENNETT

In its capacity as the U.K.'s Silicon Valley, the city of Cambridge has provided the setting for the development of two important network systems — the Cambridge ring and now, Acorn's Econet. Bill Bennett looks at the Econet broadcast network, its future in education and offers an example computer-aided-learning program of the type the system might use.



CAMBRIDGE has in the recent past made a concerted effort to establish itself on the map as the centre of the British microcomputer industry. It may be on a small scale in comparison with California's Silicon Valley, but the innovation and imagination on display is still impressive.

There is already a clutch of companies offering implementations of the Cambridge

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(continued from page 23)
programs in isolation from the rest of the system. It is possible for Atoms to input and output data to other terminals on the network in real time — that is during program execution — but this requires the processor to stop to transmit and receive.

Herman Hauser and Chris Curry both recognise the enormous importance of the role micros will play in education and they admit that there is a huge potential market in schools and colleges.

The specifications for Econet

- Up to 255 stations per net.
- Econets can be connected to each other by gateways.
- Connections between stations can be by inexpensive, four-wire cable.
- Stations can be separated by up to 1Km.
- Data transfer rate of up to 210 kilobaud.
- Differential signals for high-noise immunity and minimal radiation.
- Clash-detect circuitry and collisional arbitration algorithm minimise the need for re-tries.
- Econet software resides in 4K ROM, which easily fits on the Atom board.
- Econet executes automatically on break, BRK.

The micro is important both for teaching how to use a computer — that is programming and operating — and for computer-aided learning where the computer is a mere tool.

The directors of Acorn see computer-aided learning as the major market for Econet, but they also realise that there are other applications; for example a businessman might consider buying a system for more cost-effective processing.

Let us now consider a typical Econet system installed in a school. The Acorn Atom is a small microcomputer, supplied with a rugged case, a full QWERTY keyboard, like a typewriter, and an enhanced form of Basic which resides in ROM, Read-Only Memory.

A ready-built Atom requires no more than a power supply and a TV screen for the user to begin programming. At a cost of around £150, plus TV monitor — there are plenty of second-hand TV sets about — the expense of providing each student with a computer is not prohibitive.

However, the cost of line printers to obtain hard copy, and of disc units would be very high. The use of a network means that money and time can be saved by the purchasing of a single printer shared by several micros, and a central disc unit would provide a common database.

At the beginning of a session, an instructor or teacher will be able to load the program into the students' computers. Having done that, the teacher will be able to monitor the students' screens giving help when required. If hard copy is required, permission can be granted from the instructor's terminal and the printer will spring into life. There are various securities built into the system, including the protection of certain files being read by unwelcome eyes.

Most people tend to associate computer-aided learning, or CAL, with the teaching of computer science itself, or with mathematics — the example program is, in fact, a mathematics test. The real advantages of CAL are not in the teaching of such cut-and-dried subjects, though, but when it is used in conjunction with high-resolution, and maybe even colour graphics.

One of the most important features of CAL is that it tends to use to the full graphics facilities of the host machine. This means that all manner of subjects can be taught in a CAL environment. For example, technical drawing is an important subject and to provide trainee engineers, draughtsmen and architects with a solid background, they must learn the principles of technical drawing.

As taught at present, it is a dry subject and some of the more esoteric concepts are difficult to grasp. A well-designed CAL program could be designed using graphics to teach such concepts as differing perspectives by actually rotating a drawing on the screen about one or more of its axes.

The Acorn Econet is capable of providing the high-resolution colour graphics facility of the fully-extended Atom microcomputer. High-resolution is the technical way of saying that the picture is of a better quality.

Normally, a microcomputer will break the video screen into about 1,000 cells.

Each cell can be filled by any one of a choice of "characters". High resolution means that the screen is broken into even smaller constituent parts. The highest resolution of all would mean that each individual phosphor dot would be addressable.

Of course, as with everything in this world, you cannot have something for nothing — the price you pay for higher resolution is that it occupies a good deal of memory. The Econet system, using Atoms, is capable of producing good, high-resolution colour graphics.

High-resolution colour graphics are not simply a case of art for art's sake. They can be used in a large number of creative teaching applications — geography with real maps, rivers of blue, coloured contours and so on; social sciences and economics with graphs, pie charts, etc., making facts easier to absorb. These then are the advantages of a good-quality CAL package which uses the graphic facilities available to the full.

There is one other consideration, though — a CAL program must be capable of holding the student's interest. Once the initial novelty of learning by computer has evaporated, it might be difficult to stop the O-level history class from gazing out of the window at the sixth form girls playing tennis. To prevent this from becoming too much of a problem, a good CAL program would feature a busy display.

Another feature of CAL is the security of the program — as most teachers know, if students can cheat, they will. One very real problem when running a CAL program is that the students could simply list the program and read the answers from data statements or whatever.

The solution to that problem is to compile the programs. That means the program is converted from the high-level language into machine code. Compiled programs run faster than interpreted ones and because they are written in machine code, they are unreadable.

The sample program is a simple CAL program, written in an afternoon in Basic. Rather than compile it, another method has been used to ensure security — the questions are based on arithmetical operations between two random numbers.

If you own an Atom, why not try this program on your computer? — you may even improve your mental arithmetic. To help you to follow it, a good deal of the program makes use of the REM statements. If it takes up too much space on your particular Atom, deleting the REM lines should help.

Mathematics program.

```
.00  CLEAR 0
150  X=10 ; Y=0 ; S=0 ; T=0 ;
N=0
200  PRINT"  YOUR COMPUTER
MATHS TEST "'
300  L=S  ;  GOSUB 10001
400  A=RND%(X-Y)+Y
500  B=RND%(X-Y)+Y
600  PRINT" A+B=C "',
700  PRINT A," +
"',B',"--------"',',"--------"'
800  N=N+1
900  PRINT $11,$11
1000 INPUT C
1100 IF C=(A+B) THEN GOTO  7000
1200 FOR I=1 TO 12  ; PRINT $9
; NEXT
1300 PRINT" INCORRECT , TRY
AGAIN "'
1400 T=T+1  ; IF T>3 GOSUB 8000
1500 PRINT $11
1600 FOR I =1 TO 32  ; PRINT$8
; NEXT
1700 GOTO  1000
7000 S=S+1-T ; T=0
7150 MOVE 30,18 ;  DRAW 52,4 ;
DRAW 62,38
7200 W=2  ;  GOSUB 10002
7300 CLEAR 0
7400 PRINT" YOUR COMPUTER MATHS
TEST "',
7500 PRINT" SCORE    ",S',',"
QUESTIONS ASKED "'
7600 FOR I=1 TO 8  ;  PRINT' ;
NEXT
7700 W=2 ; GOSUB 10002
7800 IF S>5 AND (10*S/N)>6 THEN
GOSUB  9000
7900 GOTO  200
8000 CLEAR 0
8100 MOVE 15,5 ; DRAW 58,42 ;
MOVE 15,42 ; DRAW 58,5
8200 FOR I=1 TO 120  ;  WAIT  ;
NEXT
8300 CLEAR 0
8400 PRINT"THE ANSWER IS "'
8500 PRINT
A,"+"',B',"--------"',
(A+B)',"--------"'
8600 RETURN
9000 CLEAR 0
9100 Y=Y+1  ;  X=X+10
9200 PRINT"THE PROBLEMS NOW GET
HARDER "'
9300 W=3 ; GOSUB 10002
9400 RETURN
10001 FOR I=1 TO L ; PRINT' ;
NEXT ; RETURN
10002 FOR I=1 TO (W*60) ; WAIT
; NEXT ; RETURN
```

LANGUAGES

IN SEARCH OF THE

Peter Laurie sets out on a quest to find the standard form of the most widely-used programming language, Basic. On this perilous journey, he treads the marshy ground between standard and eccentricity where machines speak in strange tongues and he explains the origins of these obscurer dialects.

THE MOST important thing about a human language is that more than one person should understand it. It is no good each individual having his own set of squeaks and grunts: they must correspond accurately to the squeaks and grunts favoured by the chap next door, or nothing will happen.

However, people being the perverse creatures they are, the original, pure fount of language has become muddied and diluted during the history of man so that there are now a myriad of different languages in the world and more developing every day.

Although computing is thought, by people outside it, to be scientific, pure, logical, it is actually just like any other sphere of human activity: messy, arbitrary, illogical — and occasionally charming. One vivid demonstration of that lies in the variety of programming languages we enjoy — or have had inflicted on us. In microcomputing, one finds a list which runs — give or take a few:

- Algol — the first language, so pure it originally had no provision for input or output
- Fortran
- Cobol — there are now 60 different dialects, with several on micros
- Lisp
- Basic — there must be 100 dialects for micros, let alone bigger machines
- Pilot
- Forth
- C — usually called "C Language" because "C" is over before you have heard it
- Pascal

And so on.

Since the vast majority of micro users know Basic, this otherwise rather amusing proliferation of languages and dialects boils down to the problem of standard Basic.

In theory, of course, Basic is standard. Rules are laid down and anyone who sets out to write a Basic should stick to them. The trouble is that there is always some new tweak the designer of the latest machine wants to incorporate so as to convince the punters that his machines are better than all the rest. So, he invents a new command for his Basic, and then finds that the new command clashes with a few of the old ones, so he changes that, which in turn interferes with a few more.

There you are — another highly-optimised, user-transparent implementation of Basic with significant advantages over previous versions. All this presents, as we have said, the micro users with some very real problems.

To begin with, things are satisfactory. You unwrap your little wonder from its box, disentangle six short circuits, put all the loose chips back in the nearest holes and you are off. The Basic in the manual is — God willing — the Basic the machine understands. The headache you feel is nothing more than a British Standard (Micro-based) Headache as issued.

Yet the trouble starts just when things seem to be going so well. You have the rudiments of Basic — as it seems, the only Basic in the world — and you think you will try your hand at some enticing programs. You take the listing in one hand, the wonder in the other and start typing. Straightaway:

```
20 DEF FNFAC(I)
30 IF I=0 THEN FNRETURN 1
40 FNEND FNFAC(I-1)*I
```

What? A frantic search of your manual reveals nothing remotely similar. What does it do? What does it want? Well, it is simple really; just a multi-line, user-defined function in the Research Machines now-obsolete extended disc Basic to calculate factorials.

You could do the same thing with a subroutine:

```
5 INPUT "number"; I: GOSUB 10
6 PRINT FACT
7 GOTO 5
10 IF I=0 THEN FACT=1: RETURN
20 FACT=I
30 I=I-1
40 FACT=FACT*I
45 IF I=1 THEN RETURN
50 GOTO 30
```

Or something along those lines. This unnerving experience is, unfortunately, only too familiar to anyone who strays outside his own familiar Basic. What can one say about likely danger areas and how to cope with them?

Firstly, there is a small core of commands which most Basics seem to have preserved: LET, GOTO, FOR. .TO, PRINT. I am deliberately not attempting a full list. Even a program written in these apparently simple commands may not run on your machine. Why so? Because, for instance, your device may deal only in integer numbers — being a little simple-minded — while the programmer assumed — all careless as a summer cloud — that all computers could cope with floating-point numbers.

Floating point? Well, the language designer has a number of choices. One of them is how to represent numbers in the machine. The easiest is "integer" which means integer numbers ranging from 1 to 65,536 — 256^2. He can do this with two bytes, and that is convenient because most microprocessors have facilities for doing arithmetic on two bytes together.

In practice, he may use the most significant bit for the sign, and give the programmer integers between +32,768 and —32,767. This makes the arithmetic routines easy and saves space in memory but is not frightfully useful, because you cannot easily calculate how much cake each of three people should receive — and other similarly pressing questions.

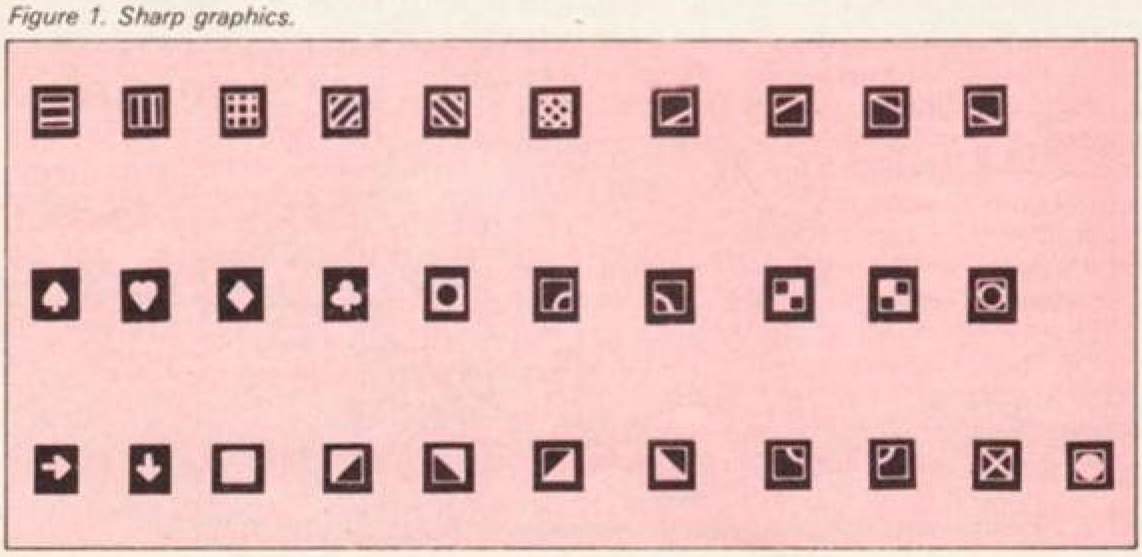
So, better Basics do things in another way. They store numbers in two parts very like scientific notation: as a two- or four-byte mantissa and a two-byte exponent. So:

226453 E-3 = 226.453.

A reasonably-sophisticated Basic like Microsoft MBasic lets you choose by putting symbols after the variable name:

```
PI # double-precision
MINIMUM! single-precision
LIMIT% integer
```

Figure 1. Sharp graphics.



STANDARD BASIC

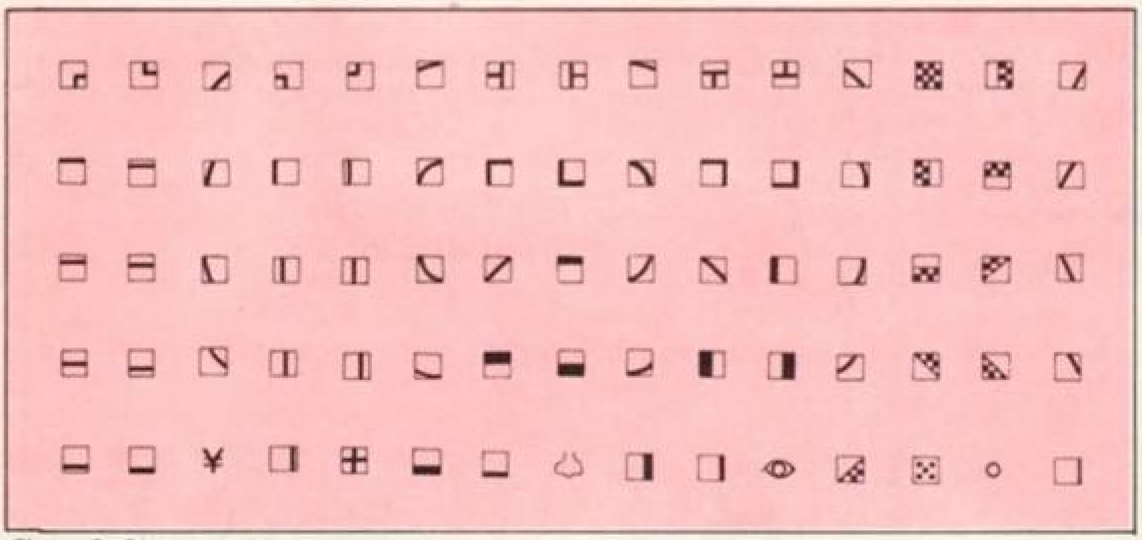


Figure 2. Sharp graphics.

Or you can declare all variables whose names start with a particular letter of the alphabet as being a particular type. Thus:

```
DEFINT D-L
```

makes everything with names starting D,E,F, G,H,I,J,K,L into integers.

Another puzzler is that different Basics have different rules about variables. The simpler allow a letter plus a second letter or a number: "A", "B", "K9", etc. Others allow up to eight letters. Others again allow up to 40 characters or even more. So the translator has to change all the variables before he can start.

Another fruitful source of difficulty is printing. Most Basics allow "PRINT" or "?" for the screen, but when it is a question of printing on the printer, they become most peculiar. Three Basics I use regularly insist on: "LPRINT", "PRINT/P", "PRINT #2" and there are no doubt many more.

Saving programs or data on disc or tape are again often mysteries. Tapes are difficult enough, but every disc Basic has its own very definite ideas about what should happen. The scheme is usually that you open a named file and give it a "channel number" in one statement. Thereafter that file is called, for short, by its number. Thus:

```
10 OPEN "I", 10, "DATA"
```

might, if you are lucky, open a file called "DATA.BAS" for input to the computer and give it the number 10. Your Basic might, however, just as likely want

```
OPEN "DATA" AS INPUT, 10
```

and so on. Translation from one to another requires a good deal of telepathy.

Having numbered a file there are then usually totally different schemes for serial or random access. Translation from one to another without both manuals is usually quite impossible. Some Basics have PRINT USING statements which let you format data on the printer. Here again, there are variants. XDB lets you go:

```
100 A = 1059/623
110 PRINT USING 120;A
120!
or
130 PRINT USING "# ";A
```

which will result in 16.80 appearing on the screen, when the answer is actually 16.809523. Many Basics do not, however, have a PRINT USING at all and you just have to tolerate masses of decimals even when they do not mean anything.

So far, we have been treading the marshy ground between standards and eccentricity. When we reach PEEK and POKE, things get out of hand. These two commands, as we all know, look into and retrieve from memory. Very useful they are, too, so long as you do not POKE into some part of memory which your Basic, or the machine's monitor, thinks is its private patch. The results can be unnerving.

The program author will — one hopes — have chosen a blank space in memory where he can romp about. His Basic may have some command which limits its spread, so as to leave a blank space. Very often Basics work in from both ends of available memory — the language proper at the bottom, then the user's program, a space for the user's program's strings and variables, and moving down from the top, the Basic stack.

One common method of freeing space for POKEs is to move the stack space down to leave room between it and the upper monitor. Certain other machines may, of course, work in a totally different way. Again, to do a satisfactory translation, one needs a memory map of both machines.

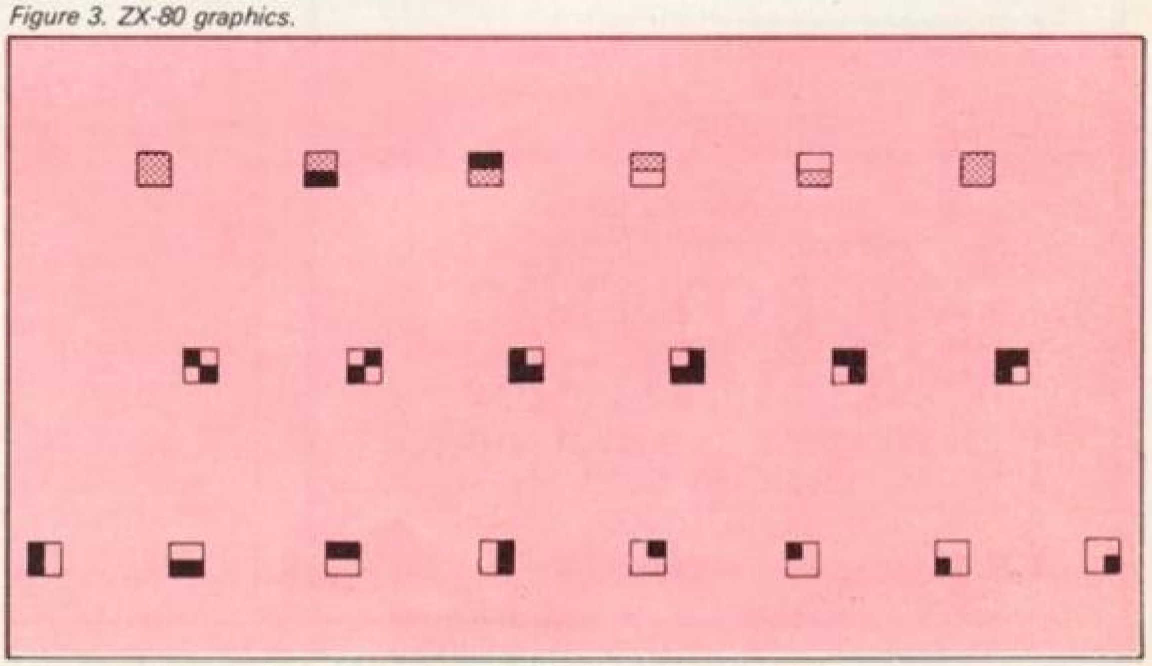
Finally, a minefield of graphics. For some reason, the manufacturers of small machines are convinced that their customers are dying to draw pictures on the screen. To help with this innocent aim, they provide a number of funny looking shapes and textures which fit into the square on the screen usually filled by a letter or a number. These are known, rather arbitrarily, as "graphics".

Each one corresponds to one of the 256 characters available, but of coure, no two manufacturers' graphics are the same. The Sharp set looks like those shown in figures 1 and 2.

The ZX-80 graphics appear like those symbols shown in figure 3.

If you are trying to translate a program from one to the other that has a drawing of a great big bug-eyed monster as an essential part, you must extract the graphics symbols from one program, assemble them by hand on a piece of paper and then try to find symbols on the second machine which match the first — and the best of British luck. ■

Figure 3. ZX-80 graphics.



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The black art of ZX~80 PEEK and POKE

BY MARTYN THOMAS

MANY VERSIONS of Basic contain three powerful statements which are the keys to a completely different world of programming. The three statements are PEEK, POKE and USR, and the world they reveal is one in which ROM has no secrets, and the full power of your microcomputer can be yours for the first time.

PEEK, PEEK and USR exist in most larger Basics, but they are omitted in some smaller versions. The Level 1 Basic on the Tandy TRS-80, for example, lacks these facilities. However, Sinclair Research has put them into the ZX-80, greatly increasing the versatility of the machine and its attractiveness to serious programmers. This article concentrates on the ZX-80, but the same principles apply to PEEK, POKE and USR on any computer.

Many programmers are put off by the apparent difficulty of learning how to use these low-level functions and believe that you need to understand microelectronics and machine-code before you can make use of them. In fact, PEEK and POKE can widen your programming horizons without any knowledge of machine code at all.

USR requires some additional understanding, but this can be acquired quite painlessly by experimentation and with only a little guidance necessary. First, however, it is necessary to form a mental image of your computer's store and how it is arranged.

Computer memory or store can be thought of as a very long row of jam jars, standing shoulder to shoulder, each with a single number inside. The cheapest ZX-80 contains 5,120 of these jars and they are of two kinds, ROM and RAM.

ROM, read-only memory, can be thought of as store where each jam jar has its lid firmly screwed on. You can see what is in the jar quite clearly by looking through the glass, but you cannot replace the contents by something else. ROM is therefore read-only; its contents can be read but cannot be changed.

The other kind of store, RAM or random access memory, can be thought of as jam jars without lids; the contents can be read exactly as with ROM, but they can also be changed so that there is a new number in the jar.

The names, ROM and RAM, are rather misleading, since both forms of store are random-access — that is, the contents of the jars can be read in any order. The important differences are that numbers in ROM cannot be overwritten and that numbers in RAM will disappear if the power to the computer is switched off — to be replaced by rubbish when the power is switched on again.

The real name for store locations is bytes — pronounced bites — and each jam jar represents a single byte, but keep the image of the row of jam jars in mind; it will help in understanding how your computer works.

The basic ZX-80 contains 5,120 bytes of store, 4K — 4,096 — bytes of ROM and 1K — 1,024 — bytes of RAM. The K stands for kilo-, a prefix meaning thousand as in kilometer or kilogramme. However, computer engineers are an odd species and they have chosen to make K stand for 1,024 just because it is a power of two and this turns out to be convenient. This is yet another example of the way computing manages to be deliberately confusing.

The 4Kbytes of ROM contain the programs which drive the television display and the cassette recorder, read from the keyboard, and interpret the Basic programs you enter. The nature of ROM ensures, as we have seen, that these vital programs cannot be destroyed by a programming error or lost when the power is switched off.



The 1K of RAM contains everything else, everything that has to change from program to program, or minute to minute. This includes the data to be shown on the display screen, the Basic program currently in use, and space for variables and arrays used by the program.

Each byte of store has an individual address, so that it can be referred to when its contents are to be read or changed. Again, for their own convenience, computer engineers number storage locations from zero, so that the first byte has address 0, the second 1, the third 2 and so on. The 4K bytes of ROM are therefore numbered 0 to 4,095.

The first of our low-level functions, PEEK, gives us just what its name implies: a way to look at the contents of any byte — to PEEK in to the jam jar. If we want to look at the contents of the 50th byte all we need to do is to type

```
PRINT PEEK(49)
```

as an immediate command. Remember the store is numbered from 0 so the 50th byte has address 49. PEEK(n) has the value contained in the byte whose address is "n", so the same result could be obtained by the program

```
10 LET A = PEEK(49)
20 PRINT A
RUN
```

It can be very interesting to PEEK about in ROM to see what is stored there. Try writing a program which uses PEEK inside a FOR-NEXT loop to display whole chunks of ROM, printing both the decimal value and the equivalent graphics character for each byte, using CHR$(PEEK(n)) to obtain the graphic.

You will soon notice that the value of PEEK (anything) is always in the range 0-255 and may wonder why this is. The answer lies in the nature of computer hardware. Each byte is composed of a set of eight bits — short for BInary digiTS — and since each bit is capable of holding only the value 0 or 1, a byte can hold only the binary values 00000000, decimal zero, to 11111111, decimal 255.

To use values greater than 255, it is necessary to use more than one byte, which is exactly what the ZX-80 Basic does to hold its numeric variables. They are stored as two consecutive bytes, giving a range from 0 to 65,535 — binary 0000 0000 0000 0000 to 1111 1111 1111 1111. The design of the microprocessor in the ZX-80 makes it more efficient to store the first half of the binary number after the second half, so the value of a two-byte field should be printed by

```
PRINT PEEK(n+1)*256 + PEEK(n)
```

This returns us to the point where we understand PEEK well enough to explore ROM, and to display and understand the values of the system variables described in Appendix III of the Sinclair *A course in Basic programming* supplied with every ZX-80.

By now, however, most programmers will be itching to change the contents of a few bytes rather than just PEEKing at them. This is where POKE enters.

```
POKE address, value
```

writes "value" into the byte at "address". If "value" is greater than 2355, it will be divided by 256 and the remainder will be written into store.

Obviously, POKE to addresses in ROM will not do anything, as ROM contents cannot be changed. For POKE to work, the address given must be in RAM, so the first question is: Where does RAM start?

You might be forgiven for thinking that RAM would start at 4,096 since ROM ends at 4,095 but life — and especially computing — is rarely that simple. Clive Sinclair has designed

(continued on next page)

(continued from previous page)

his ZX-80 for expansion, and left room for up to 16K of ROM — an 8K ROM has already appeared along with this year's Sinclair computer, the ZX-81.

This means that RAM starts at address 16,384 and continues from there. The first 40 bytes are the System Variables referred to before, and these give us our first chance to see what POKE can do. Let us look at a simple example.

Addresses 16414 and 16415 contain the frame-counter for the television display, incremented all the time a picture is on the television screen. The value in these two bytes is incremented 50 times every second in the U.K. version; 60 times a second in the version sold in the U.S.A. So, it can be used as a simple, and reasonably accurate, timer.

Using POKE we can set the value to zero; if we then invite the viewer to press Newline and immediately PEEK at the current value we can see how many 50ths — U.S.A. 60ths — of a second have elapsed. We have a primitive "reaction timer". How does this look?

```
 10 REM    REACTION TIMER
 20 REM    FIRST SET THE COUNTER ZERO
 30 POKE  16414,0
 40 POKE  16415,0
 50 REM    NOW ASK FOR INPUT
 60 CLS
 70 PRINT  "PRESS NEWLINE"
 80 INPUT A$
 90 REM    FIND OUT THE TIME
100 LET TIME = PEEK(16415*256+PEEK(16414)
110 PRINT   "YOU TOOK"; TIME*20;
            "MILLISECS"
120 STOP
RUN
```

This example shows the power and simplicity of PEEK and POKE, but it only scratches the surface of their full capabilities.

For example, once the screen has been written to be entirely full of spaces, it is reasonably easy to write characters directly to the display file using POKE. This means they are printed without using PRINT and it is possible to write anywhere on the screen — say, for drawing graphs or pictures — without the constraint of having to write line-by-line from the top of the screen downwards.

The exact way to do this can be discovered by the diligent programmer from the appendices in the Sinclair *Course in Basic programming*, now that we have examined what occurs. A fuller explanation, and examples of ways in which space and time can be saved in many programs, must wait for a future article. This one must stop with a few remarks on USR.

The microprocessor inside your computer, as you probably realise, does not execute Basic directly; it executes a machine-code program in ROM which then interprets the Basic. Using POKE, we are in a position to write our own machine-code programs — all we must do is to write them as a series of decimal numbers and POKE them one at a time into an unused area of RAM.

USR gives us the final function we need to be able to exploit this. USR allows us to execute a program at some address in RAM or ROM and, optionally, to pass a value back to be used in the Basic program.

This opens the possibility of true machine-code programming — the key to all the power of your microcomputer. Machine-code programmming is difficult because you need to understand the primitive instructions the microprocessor obeys.

It is also error-prone and slow to write. Nevertheless, it provides a fascinating insight into the structure and power of a bare microprocessor, and can be educational as well as enthralling.

Introducing microprocessor architecture and machine-code programming is beyond the scope of the present article and must await a future issue, although impatient readers will find many books on machine-code programming in bookshops.

Any book which describes the Z-80 microprocessor in detail will do for ZX-80 owners — many have been written and reviews of several have appeared in our sister publication *Practical Computing* in the last few months.

Readers content to experiment with PEEK and POKE and wait for a future article on machine-code programming might, nevertheless, be interested in a simple demonstration of how USR works. The key to this demonstration is the fact that in ROM, at location zero, is the program which clears memory when the power is turned on.

This routine is also used to implement the Basic command NEW. Thus NEW and USR(0) are identical. Put a call USR(0) in a short program and see what happens — USR calls the routine at address zero and the program disappears. ■

RESPONSE FRAME

BEST COMPUTER?

■ I want to buy a cheap computer. Which is the best one to buy?

P. Hadyn, Wilmslow SK9 5DY.

THIS question is unanswerable unless you know how much money you want to spend on a computer and what you want to do with your computer once you've bought it. Your question implies that you have little experience of computers, so we'll assume you want a simple, low-cost machine, suitable for a beginner.

There are a number of computers for less than £200, including the ZX-80, the ZX-81, the Acorn Atom, the PC-1211 and the Commodore Vic. The PC-1211 is more like a calculator which speaks English than a computer, and because its display is limited to a single, liquid-crystal line, it cannot be considered seriously as a personal computer — although they do make splendid "second computers", we could not recommend you buy a PC-1211 as your first one.

The Acorn Atom language is difficult, and could be bewildering for a beginner, although the computer is a solid, worthwhile one which will stand you in good stead for many years. Our opinion is that you should buy, say, a ZX-80 or a ZX-81 and use it for six months or so, then use the experience you have gained to decide which "real" computer you should buy next.

There are a number of second-hand ZX-80s on the market now for £40-£50 and we recommend you buy one of these, rather than the ZX-81. The ZX-80 is much easier to use, is more robust than the ZX-81 — which every so often shows a quaint habit of just "forgetting" everything held in its memory — and is far more flexible in the 1K, unexpanded version than is the 1K ZX-81.

The ZX-81 uses up so much memory maintaining the screen display, that an unexpanded machine has very little memory left for you to use, so a 16K pack — another £49.95 — is mandatory if you are going to do anything worthwhile with the computer.

However, with the Sinclair Research 16K pack, the computer can lose its contents without any reason, and the amount of available memory appears to shrink to around 11K after the machine has been operating for an hour or so.

Our advice then is to buy a second-hand ZX-80 and after six months or so, start looking for your next computer.

USER-DEFINING

■ I wish to "user-define" keys on my Exidy Sorcerer. How can I do this?

K Eaton, Kingsley Crescent, Nottingham.

THE FOLLOWING machine-code program, developed by Jeremy Ruston, gives you the following: round brackets, the "$" sign, quotation marks, and delete, all without using SHIFT. The routine can be adapted easily to assign other functions to the keys of your choice.

Enter the following via the monitor at a convenient address. The routine is fully re-locatable. With this in memory, you'll find you obtain round brackets from the square brackets keys, $ from TAB, quotation marks from the back slash — next to the delete key — and delete without having to use SHIFT.

```
CD 18 E0 CALL INCHR
28 FB    JR Z, -4
FE 5B    CP 58; i.e., left square
         bracket
28 11    JR Z, 11
FE 5D    CP 5D; right square
         bracket
28 11    JR Z, 11
FE 5C    CP 5C; reverse slash
28 11
FE 5F    CP 5F; delete without
         shift
28 11
FE 0B    CP 0B; TAB
28 11
C9       RET
3E 28    LD A, 28; left round
         bracket
18 0E    JR 15
3E 29    LD A, 29; right round
         bracket
18 0A    JR 10
3E 22    LD A, 22; double
         quotes
18 06    JR 6
3E 7F    LD A, 7F; delete
FE 00    CP 0
C9       RET
```

Once you've entered the routine, type — still in the monitor — SE I = start address. Keys will function as defined. Note that by changing the numbers after the "3E", you can change keys as you choose.

SUPERPET QUERY

■ What is the SuperPet? I have a 16K Pet at the moment. Can I upgrade into a SuperPet?

N Wilson, Haverfordwest, Dyfed, Cymru.

THE SUPERPET is the popular name for the Commodore Model 8032 derived from the 8000 series plus the 32K of internal RAM. The SuperPet is Commodore's excursion into the small business market, and unless you have a spare £3,000, it is not for the average computer hobbyist.

It uses the Microsoft Basic interpreter, so programs written for older Pets will still work on it. It would be possible to upgrade to a SuperPet but much modification would have to be undertaken.

MICROTAN KIT

■ I am puzzled by the Tangerine advertisements for Microtan 65 systems. How much does one actually have to buy before one has a fully-operative computer? By this I mean a system that uses Basic. I'm not up to assemblers yet.

P Thornton, Selly Oak, Birmingham, West Midlands.

THE BASIS of the system is the Microtan 65. This contains the 6502 microprocessor, a 1K monitor, 1K of RAM for user programs and the display memory. Add to this the Tanex board which gives you another 1K of RAM — expandable to 7K — cassette interface, 16 I/O lines, memory mapping and, other goodies.

The Tanex board can be expanded with a 10K Microsoft Basic ROM, and the X-bug which is essential if you want to Save and Load in Basic. There is also space for a variety of other integrated circuits — printer drives, etc.

Tanex is joined to the Microtan 65 by the Mini-motherboard. Add to this a 71-key ASCII keyboard and a power supply and you are ready to start computing. All this will cost you £322.90 including VAT, or less if you choose the kit.

Alternatively, you can pick the Micron system which contains all these things plus the extra RAM and integrated circuits on the Tanex board. The £395 including VAT for the Micron also includes cases for the keyboard and the Microtan and Tanex.

Either way it represents good value for money and an excellent computer system.

ACORN SOFTWARE

■ Please could you tell me of any software firms interested in buying programs for the Acorn Atom? I have a variety of games and advanced graphics programs. *Martyn Smith, Shrewsbury, Shropshire.*

THE BEST way to find firms to buy your programs is to look through the software advertisements and write a short, clear letter explaining exactly what programs you have, and the size machine they demand, to those firms which appear to be selling similar material to yours.

We suggest you could try Acorn Soft, 4a Market Hill, Cambridge; Bug-Byte, 251 Henley Road, Coventry, CV2 1BX; or The Software House, 146 Oxford Street, London, W1.

SHARP GRAPHICS

■ How can I create moving graphics easily on my Sharp MZ-80K?

C. Hopper, Queensborough, Kent.

THERE ARE at least three ways to make things move on the MZ-80K. The first way is by using blocks of Set and Re-Set to build up whatever you want to move. The co-ordinate of the top-left hand corner for Set/Re-Set is 0,0 and the bottom right-hand corner is 79, 49. This is a slow way of making things move, and is not recommended beyond the use of a single spot as a bouncing ball.

The second way is to POKE directly to the screen. The first address — that is, the top left-hand corner of the screen — is 53248, and 54247 is the address of the bottom right-hand corner of the screen. There are thus 1,000 points on the screen, and you can POKE the character or your choice into the position of your choice with the command POKE 53248 + X — where X is a number from 0 to 999 — Y — where Y is the character being POKEd. You will need to "unPOKE" the character from its old position when making the characters move.

The third way, and by far the easiest and most flexible, is to use the inverse arrows on the front row of keys. Input the number of arrows you need, within the quotation marks, preceding the material you want PRINTed.

You can place the arrows within a loop or — to run much more quickly, even though it is very boring to program — enter line after line, changing the complete set of arrows in each one. The Ten-pin Bowling program supplied by the manufacturers shows how effective this is.

VIDEO GENIE BUY

■ Is it true that TRS-80 software will also run on the Video Genie? If so, and regarding the price difference, would the Video Genie be a better buy?

T F Johnson, Colchester, Essex.

YES AND maybe. TRS-80 Level II software is compatible with the Video Genie. There are some great games available for the TRS-80 at the moment and all of them will run on the Video Genie without any problem, although the Video Genie lacks a few cursor controls which are on the TRS-80.

As to which is the best buy, both computers are well produced, but the Video Genie is more than £100 cheaper. It lacks the numeric keypad of the TRS-80, but has an integral cassette deck. The Video Genie has the same 12K Microsoft Basic, 16K RAM and expandability into printers and discs as the TRS-80.

LOADING PROBLEM

■ I am experiencing loading difficulties with my Acorn Atom. I use C60s and C90s, but I also tried two C30s I bought from my local Tandy shop. Regardless of recorder volume setting, the stored data was corrupted. I use a cassette recorder which cost £17. My second question is I am having trouble developing a program in stages, and then loading it in stages. I have found that although the Acorn Atom indicates that the second stage is saved, I obtain a checksum error when I try to load in that stage. What am I doing wrong?

H. Bell, Kildonan Drive, Glasgow.

I AM SURPRISED that you are having loading problems with the Acorn Atom as it has a very well-developed system of loading which makes errors almost impossible. It sounds as if your recorder is just not good enough. Buy a new one, and try it with your Acorn — take the computer along to the shop before you buy it. There is a good test routine for loading in your manual.

The second problem seems to be that you are trying to load the second stage of a program on top of the first stage. You can only load in stages if you start the second block of the program at an address which is not part of the first stage. ■

BBC's Proton project and

BY MARTIN HAYMAN

CONTROVERSY is still surging back and forth over the BBC's decision to put Acorn into the front-line by choosing an adaptation of its forthcoming Proton model as the "standard" micro for the 1982 series, *Hands-on micros*.

Yet, as *Your Computer* has found, the programme makers are not daunted by the doubters and backbiters from the ranks of the microcomputer professionals and are pushing ahead with their initiative to popularise computing by putting it into every home.

The series is at the moment being devised by producers Paul Kriwaczek and David Allen. They can scarcely have imagined the tremendous interest generated by their proposal to make a series which would "put computing power into the hands of the people".

At a recent presentation, no fewer than 500 people in the educational world attended to hear Kriwaczek's and Allen's ideas. The consensus now seems to be swinging towards a more serious, considered and informative approach than perhaps had first been envisaged; less entertainment, more information.

In this, they have been influenced, too, by the results of a large-scale market research study done by the BBC which quizzed the "man in the street" on his interest in, and attitudes towards, microcomputing. David Allen says that though many people admit to an element of fear, there is, nonetheless, a keen



the nuclear family

general interest in learning "what it's all about". The fear, of course, is about jobs; the micro has widely been presented as a destroyer of employment.

It is this, together with the jargonistic aspect of micros about which Kriwaczek and Allen as beginners are learning, which has prompted them to refer to the whole idea of *Hands-on micros* as "The All-England DOS-booting Contest".

David Allen says that jargon will be explained where it is useful: "Clearly, there are buzz-words and people want to know what they mean. The more we know about it, the more tempting it is to use them: but we need to explain them first in a clear, unjokey way".

The whole exercise is growing and developing in an organic way. Kriwaczek and Allen are bouncing some of their ideas off a control group of "guinea-pigs" who have been issued with a micro and proposed course notes and required to keep a diary and note their feelings as they are led into computing. There is even a hot line direct to BBC educational officer, Bob Salkeld in Leeds, who will solve their problems if they become completely stuck.

Paul Kriwaczek's interest in the micro was sparked in the first place by *Your Computer* sister journal, *Practical Computing*, in February 1980. He is a professional TV programme producer and is determined that the series, 10 half-hour slots intended for screening in early 1982, should be fully professional television, and succeed on an entertainment level as well as on an educational one.

'Put computing power into the hands of the people'

Yet there are really no fully-professional home computer users — there is a touch of the amateur about almost everyone involved with the micro. To prove the point, he would return home at night and work, sometimes until dawn, grappling with the music compiler of his Nascom. It is with pride that he told me that the series will feature some of his own music this machine produced. The late nights were not popular, though: "My wife and family aren't very keen on the micro".

Hands-on may seem to be late in the day, but it is a slow business to put a good idea into effect for a TV series — especially when the plans are as ambitious as these. The consequences of enthusiasm are unpredictable: once seeded, the idea burgeoned, and now it is hoped that as well as the BBC microcomputer, there will be several books and manuals written by serious British micro prophets, and a course in microcomputing to be run by the National Extension College in Cambridge.

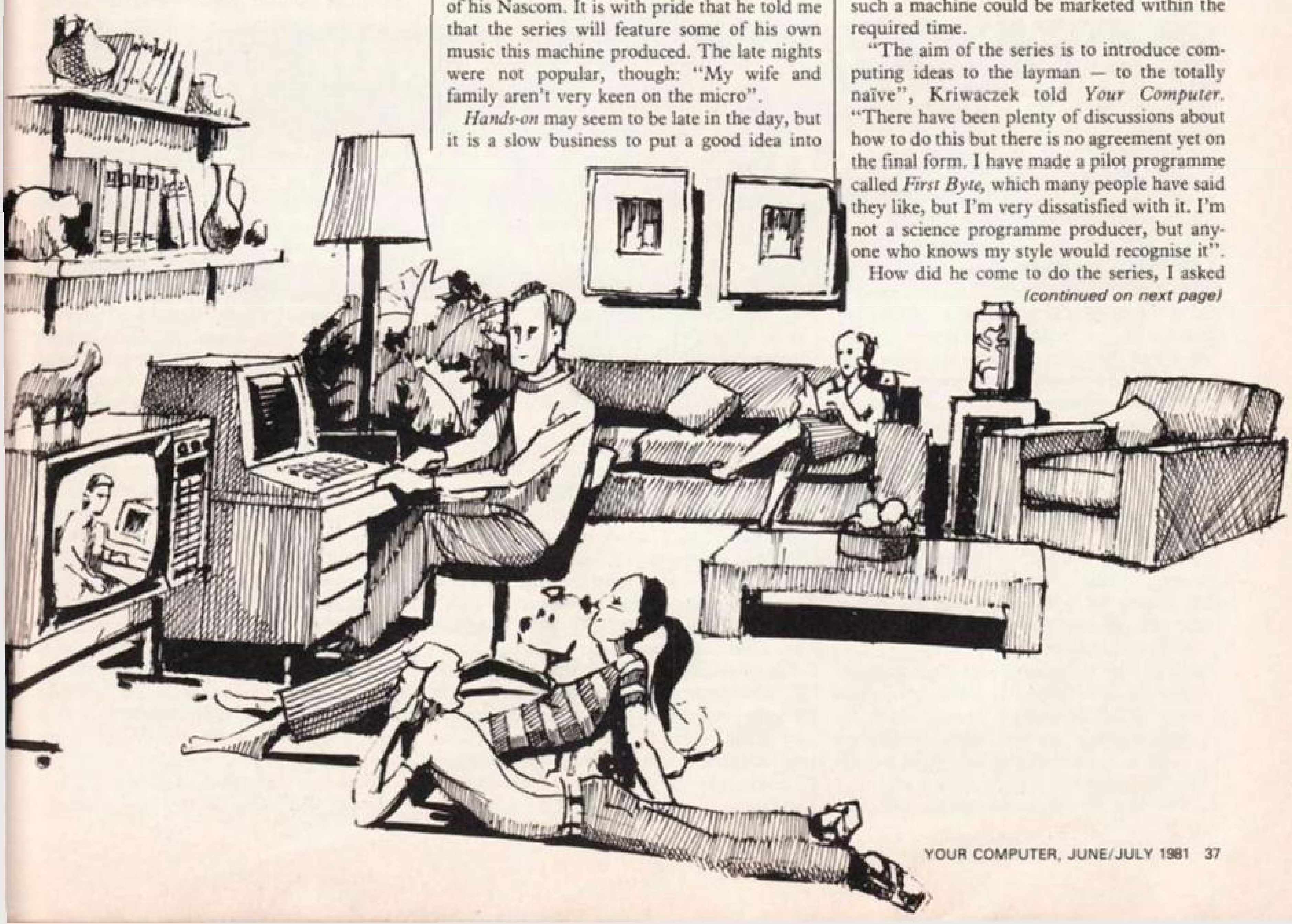
If this were not enough, there was originally an idea to devise a new standard dialect of Basic so that any programs illustrated in the series could be implemented without modification. Educational and applications software would have been sold in that language, to have been called ABC.

For the moment, though, the standard language has been deferred as perhaps an excess of enthusiasm. Programmes are not the same as programs; the covey of pundits who flocked around the watering hole generally advised against the further complication of trying to implement a new language. The micro manufacturers invited to tender for the BBC microcomputer expressed doubts that such a machine could be marketed within the required time.

"The aim of the series is to introduce computing ideas to the layman — to the totally naïve", Kriwaczek told *Your Computer*. "There have been plenty of discussions about how to do this but there is no agreement yet on the final form. I have made a pilot programme called *First Byte*, which many people have said they like, but I'm very dissatisfied with it. I'm not a science programme producer, but anyone who knows my style would recognise it".

How did he come to do the series, I asked

(continued on next page)



(continued from previous page)

him: "Funnily enough, it was my idea". He had been involved with a series called *The Silicon Factor* which had the usual scare stories — 'Did you know the micro would cut out so-and-so many skilled jobs by the end of 1984?' — which dealt with the microrevolution on the macro level.

He asked the question: "Don't we have a duty to put some of the power of computing back into the public's hands rather that just make programmes about computing"? — and to his surprise, he says, found that the series had landed in his lap.

It was only then that he thought he had better do his homework and went out and bought his own Nascom. He then found that the moral and philosphical implications of computing raised questions which were very different from those to which he had been accustomed in his usual social and working milieu.

He grew interested in different languages and systems software generally and, with the familiar obsessiveness of the micro beginner, sat up late at night trying to master it.

In parallel with learning how to program, he was exercising his mind with the relationship of computing to the general scientific scene and trying to fit it into his ideas of Western history. He is particularly fond of an analogy with Adam Smith's tome *The Wealth of Nations*, which analyses the workings of a pin factory, with its implications that an industrial process can be broken down into its component parts and work more efficiently thereby, i.e., make more money for its owner.

The Wealth of Nations is something of a seminal text in the formation of modern capitalism and Kriwaczek suggests that the same thing may now happen with information as it did with capital: the process can be broken down into its constituent parts and productivity maximised.

"In principle, the idea of programming is of trivial simplicity", he claims. "It can be used by any plumber, bus driver, hairdresser or engineering draughtsman, and this is what we intend to try and show. As it stands, the micro is a machine designed without a purpose.

"When human beings first appeared on the earth they were equipped with a fully-fledged brain, a brain with capabilities which went on to build Chartres Cathedral, paint the Giaconda and unravel the mysteries of DNA and quantum physics. None of this was of any use to him then because all he wanted to do was chase bears out of a cave. The computer is like the brain: until ordinary people start to use it, its like a machine without a function".

What kind of ordinary things did he expect ordinary folks would find for the micro to do? "I doubt that it would be controlling central heating in their homes, since control systems are already so good, nor doing the family accounts, as few families have sufficiently complicated finances.

"It's more things like multi-choice questionnaires for fault-finding in their cars — say, things which admittedly already appear in printed manuals. My favourite at the moment is cursor screen-generated graphics for knitting patterns".

The idea would be to design your own



Paul Kriwaczek, one of the programme's two producers.

pattern on the screen, which would be interpreted by the program for conventional knitting instructions. There is enormous potential for people to use this kind of limited programming expertise for their own creative purposes, thinks Kriwaczek.

He is less convinced that the micro will become a genuine, decentralised communications tool. Networked micros are unlikely to happen in so small and centralised a country as the U.K., he thinks, though he reckons that the micro enthusiast will gradually merge into a more general class of practical micro user.

He admits that it will fall outside the brief of the programme series to explore the philosphical implications of microcomputing. He will have enough on his plate to devise a series which is both sufficiently informative and entertaining to grab the layman's attention — especially if the programme is not to be relegated to a dead slot in the programme schedules: in educational time, or in the afternoon or late evening: "I'm not prepared to accept that; if it's worth doing, it's worth doing properly".

'The micro is a machine designed without a purpose'

For a flavour of how it will look on the screen, I asked Kriwaczek to give *Your Computer* a blow-by-blow account of the pilot programme. It is to be hosted, he told me, by Chris Serle of *That's Life* fame, who will represent the interested layman — as well as the experienced TV linkman.

Serle has no grounding in the discipline of computing and may reasonably be expected to ask questions which the computer user may think elementary. He introduces the programme with a quick run-down on the "unnoticed revolution" of microcomputing: "You can now walk down the High Streeet of any major town and buy a computer for cash".

He is then joined by Little Genius's Jonathan Baldikin, who will be Serle's informed sidekick. Baldikin then demonstrates a cash-register-connected program which he wrote — running on a Heathkit. The familiarity of stock-control is intentional, to introduce the audience to tangible duties of the working life which can be alleviated by the micro.

A retailer's work is not done the moment he steps out of the door and locks up: he must note and collate all his sales and prepare the following day's orders. Instead of laboriously checking all of this by hand, brain and pen, he is shown consulting his micro.

This may seem obvious and banal to existing users, but the sequence is intended to demonstrate that such a routine can be both labour-saving and essentially personal — no need of impersonal mainframe-linked point-of-sale terminal.

The next sequence is a visit to the National Microprocessor Centre where several different machines and programs are shown at work. The point is made, though not explicitly commented on, that input and output from a micro can be had in other forms than those of the keyboard and VDU.

Then we return to the studio where Baldikin leads Serle through a very simple Basic program — a short geography quiz — whose requirements are laid down by Serle and interpreted by Baldikin. This is then extended via a film clip centring on a pirate map with directions to find the buried treasure. Again, the emphasis is on reducing knowledge to its component parts.

"The major educational thrust of the series is no less than to change people's model of the world", comments Kriwaczek, "from a holistic to a component-based view. That really seems to me to be the most fundamental part of the series. Here is where my other hat, of programme maker, appears".

He develops his theme by comparing Basic with Pascal. The former, he says, is like slicing a carrot: you don't understand a carrot from a single slice, but you can put it back together again. Pascal, on the other hand, is like the layers of the onion: each one contains sufficient information for a holistic view of the subject.

Unhappily there will not be enough time to get to grips with any language other than Basic. "It's a shame, and I think it's a mistake. It would be useful to start with machine language", he says, "because with a high-level language you still have a black box between you and what's going on inside the computer. It's an awful compromise".

One of the issues which caused controversy and certainly disagreement between the people who are involved in *First Byte* was the proposal to launch and market a new "standard" Basic designed for the programme and the BBC micro. Many of the advisers argued against it.

This is a reflection of the difficulty in treating the subject of microcomputing

seriously, with an educational slant, yet intelligibly for the layman.

"Eventually you have to make up your own mind", says Kriwaczek. "You can find academic advisers, and they all say different things. Few academics seem to understand the problem of taking somebody with no knowledge and interesting them enough for them to keep watching. People who are interested enough can always obtain specific information from other sources. We need to attract people who think: 'I am innumerate, I could never understand computers'."

The pilot programme continues with some location sequences shot at ICL on voice synthesis. The problem was one of supplying information to people who move around, sales representatives for example, who for obvious reasons cannot take a terminal around with them.

Access to a computer is not difficult over the telephone — a few touch tones will do — but what is tricky is to return information in a human-comprehensible form. This means an artificial voice of some kind.

The research shown is work giving that information — characteristically a string of numbers back to sales returns and stock reports — with some form of intonation. The human brain overloads quickly if there is no sign that its source of information does not understand the significance of what it is talking about. Imagine the football results read out on Saturday afternoon without the characteristic falling tone for a 2-0 home win, the equal stress for 1-1 draw, the late stress accorded to a 1-3 away win.

The program continues with a further exploration of the theme of humanising input and output of information with some old film footage in monochrome of traffic lights in operation. This is intended to develop the point of binary information theory. Also used by way of analogy is the Jacquard loom, which features 0 and 1 in the form of warp and weft and, like the computer, can construct a composite of the world with this very simplest of choices.

The whole pilot programme, at 50 minutes, runs to double the length of the intended slot and is only intended to seed some ideas for the series. Needless to say, the programme maker's story is far from the whole. Paul Kriwaczek reports to an executive producer, John Radcliffe, who is co-ordinating the overall strategy.

To date, that strategy includes the following plans:

- To market the Acorn Proton-based BBC microcomputer for less than £200. Acorn will probably subcontract assembly to Cleartone in Abercarn; the Department of Industry's £60,000 contribution meant that assembly would have to be in Britain. It will be marketed under licence from a box number, by mail-order.
- To sell a range of applications and educational software to run on the new micro. The language used will be Acorn's SuperBasic but with some enhancements to make it compatible — or compatible with the minimum of modifications — with Microsoft Basic and possibly, a BBC Basic to be known as ABC.
- To link the series with Cambridge-based National Extension College, who will run a 30-hour course on learning Basic. The course, though, is intended to be used without reference to the series if necessary.

The specification of the BBC micro has been through several important changes before being finalised. It was devised with the help of Ray Kernow, John Sweeton, John Coll and Peter de Bono, with general advice from the Industry Department. Initially, it called for a Z-80 processor, CP/M support and telesoftware and Prestel compatibility.

It was to have had its own software standard, but MUSE — Microelectronics Users in Secondary Education — chief John Coll found that it would not have been possible to implement a new standard Basic in the allotted time.

Firms who were contacted with the specification thought that the time limits were too tight, but Acorn reckoned that it could be done with a 6502 processor. The keyboard is built-in and the machine drives a conventional domestic TV set. The Atom Basic occupies 16K of ROM, as does the monitor; the machine has 16K of RAM, expandable to 32K; this can be further extended to 96K with a second CPU option.

Interfaces are RS232 parallel Centronics type, CUTS 300/1200 baud-switchable cassette, and a teletext adaptor. This last feature is specified only for the BBC version of the Proton and will allow direct telesoftware down-loading. The VDU has high-resolution graphics in black and white, 25 by 80, or colour Prestel-type, 25 by 40. ■

Essential kit~building techniques

BY JOHN DAWSON

The time spent building a kit is never wasted. Apart from the real financial savings — which can be enough on the first kit to pay for tools lasting many years — there is a certain satisfaction when the machine works which is denied to people who merely attach a mains plug to one end of a piece of wire.

BUILDING A kit of parts to make a microcomputer allows you to understand the design and how to approach faults far better than when you use a ready-made unit. Your own quality control can be higher than that of many manufacturers during the construction stage.

Above all, you may see something which does not suit your purposes as well as you would like — the irritable gremlin who spurred progress through successive technological revolutions may seize you: What if I changed this? — what happens then?

The standard of kits varies greatly from the best — for example, Heathkit — to the absolutely awful. The worst kits have missing or wrong components, no construction manual and no help available from the manufacturer. Some electronic kits are designed for amateur builders and consequently do not need special tools or high-performance laboratory instruments to complete them.

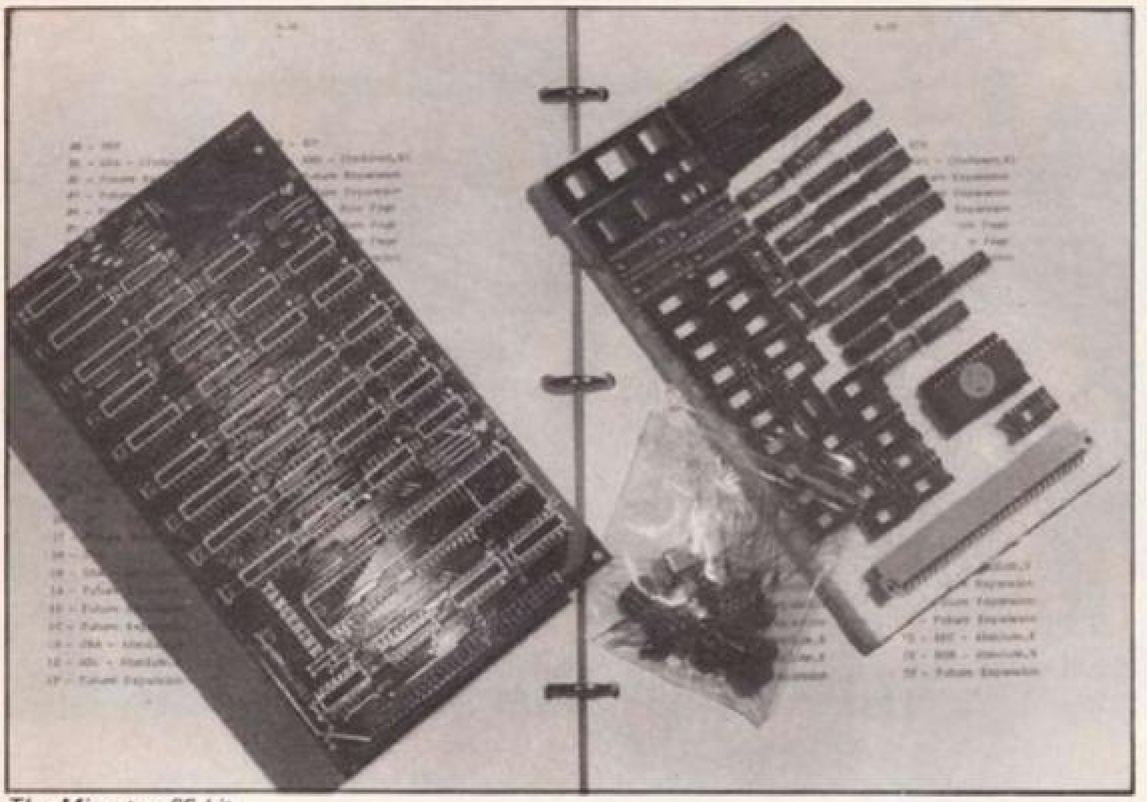
Other kits are industrial designs intended to be factory-built but supplied to you as separate components. Designing a computer which can be assembled by someone without access to sophisticated test equipment with a high probability that it will work first time is arguably a more rigorous exercise than producing a design for factory completion.

The "amateur" machine must be tolerant of wider differences in component values and should be able to cope with a wide variation in the circuit's dynamic performance. The Microtan 65 kit which I have used for the illustrations in this article is an excellent example of a well-organised and documented kit.

Building a kit is not difficult and is mostly a question of patience and methodical, careful work — looking ahead to anticipate problems before they become insurmountable. Accurate information you can easily understand is a vital part of assembling a computer at home and the construction and operating manuals are probably the first things you should examine when you start to think about buying a computer kit.

Try to spend some time browsing through the written information on a number of computers, both in technical reviews in magazines such as this one, and in the manufacturer's advertisements before you decide which machine you intend to buy. Look for these points:





The Microtan 65 kit.

1. You may need help during and after the construction stage. So, is the kit produced and packed in the U.K. and is there an address and telephone number in this country to which you can turn for advice? What happens if it does not work when you have finished building it? Is there a service centre close by or will you have to post it away for diagnosis and treatment?
2. Is the kit intended to be complete or will you need other items such as a power supply unit — PSU — television or monitor — VDU — cassette recorder, connecting cables, memory boards and so on?
3. Building a kit is one thing — doing something useful with it is another matter entirely. Is there good information in the manual about software, the instructions which will eventually program the machine to make it carry out tasks for you? Is there a list of the 'monitor' program so that you can utilise sections of the fundamental software, such as a subroutine to output a character to the television screen, for your own purposes? Does this matter to you or will your applications be satisfied by using a high-level language, for example, Basic.
4. Does the manual have a check-list for the kit components, right down to the last boring — but essential — resistor?
5. You cannot have too much information about which way round integrated circuits, transistors and diodes should be inserted, what gauge wire should be used for which connections and even which screw is destined for which hole. Is there a silk screen print on the component side of the printed circuit board, PCB, identifying the location of the components? If not, is there at least a diagram in the construction manual giving the same information? One good manual has a PCB component lay-out diagram with a superimposed grid; the components are listed with a grid reference to help find the correct location.

This is in addition to the marked positions on the PCB.

Are you expected to have more than a multimeter — see the tools' tables — for checking voltages and continuity when you switch on? If so, do you possess or have access to the test equipment mentioned in the construction manual?

Check particularly whether the PCB has tracks — wiring — on both sides. Most computer kits will have a double-sided PCB and there will be a number of connections from one side of the board to the other. A good-quality PCB will have been electro-plated through the holes, making an electrical connection. There are some kits available which require you to solder a wire connection from the track on one side, through the hole to the track on the other side. The final performance of the kit is unaffected by the difference but you will do far more soldering on the second type of PCB.

Table 1

Essential tools

- Screwdrivers
- Small sidecutters
- Large pliers with heavy-duty wire cutters
- Stanley knife or equivalent or wire strippers
- Thermostatically-controlled soldering iron
- Solder
- Multimeter
- Magnifying glass

When you unpack the kit, do it slowly and at leisure — this time is well spent. Try not to disturb the integrated circuits, ICs, but sort the other components into separate categories: transistors, diodes and light-emitting diodes —LEDs — resistors — see colour codes — capacitors — condensers — turret pins and solder tags, wire, solder, switches, and other metal pieces such as heat-sinks — and then check off each component against the list in the manual. Make a note of missing parts — very common — and put any surplus components — not quite so common — into a separate container.

The integrated circuits are of two kinds; TTL chips which are comparatively rugged and MOS chips which are susceptible to damage from static electricity. The chips which may be damaged will probably have their pins inserted through aluminium foil or be shorted together in some way to prevent a static charge puncturing the internal insulation in the chip. In the photograph of the Microtan kit, the MOS ICs are the four plugged into black conductive foam.

Do not remove the integrated circuits from their packing until you are ready to insert them into the sockets on the board. There are precautions against static you can usefully take such as not wearing a nylon shirt and using an earthed sheet of metal foil on the work-surface when you are handling MOS ICs. These may or may not be necessary depending on your surroundings — you should be aware of the problem and use your own judgment. Repack the components and settle down to read the assembly instructions.

Most good kits intended for home construction include sockets for every integrated circuit, IC, on the printed-circuit board. I would not dream of building anything as complex as a computer without using sockets — they are essential. If an IC is faulty, you will only discover this after you have finished the construction — removing an IC which has been soldered into place is very difficult.

Of course, it can be done but you run a serious risk of breaking not the IC — that is unlikely to cost more than £5 or £6 at the most — but the tracks on the PCB itself. That is probably the most expensive single component in the kit, costing up to £50.

Sockets are essential for other reasons as well, timing problems on the Nascom 1 microcomputer were cured in many cases by exchanging one IC with another and you cannot do this sensibly unless all the ICs are removable.

If there are no sockets included in the kit, it is worth buying either standard dual-in-line, DIL, sockets or the cheaper, but less convenient, Soldercon pins. These pins are supplied in long strips which can be cut as necessary. After the row of pins has been soldered, the metal supporting strip is broken off leaving each socket free-standing.

Consider also whether you wish to add additional refinements such as extra fuses or sockets for signal connections which leave the board. Does the power supply have an on/off switch, and if not, is that important to you?

Before any components are put on to the PCB, it is wise to check that no drilling or shaping is necessary to make the board fit into whatever case you intend to use. It is better to do work of this kind before you begin the assembly itself.

You will need a small number of essential tools for assembling the electronic components of a kit and there are many others specialised to do particular tasks more quickly. A list of the minimum core of tools is set out in table 1 and an additional list of useful but not essential tools is shown in table 2. *(continued on page 43)*

(continued from page 41)

If you are buying tools specially for the construction of a kit, consider that they are an investment and that it is worth buying the best you can afford. Good tools do not wear out and will last beyond your lifetime. Poor-quality tools which slip or twist sideways when under pressure are annoying to work with and make the production of neat, sound work very difficult.

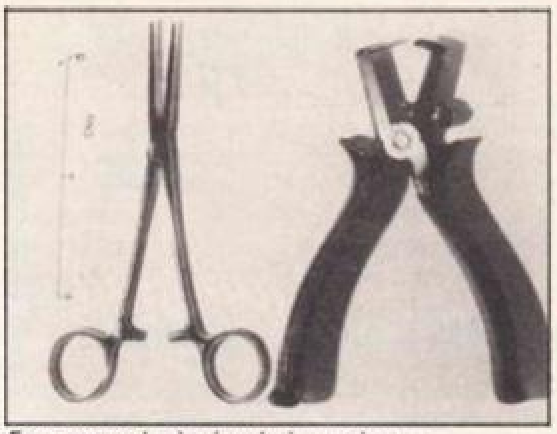
The best pliers and sidecutters have box joints at the hinge between the two moving parts. In a box joint, one side of the pliers passes through the other — all the tools I used on the Microtan are box-jointed except the wire-strippers — so that the pivot around which the pliers move has only to cope with the clamping movement as any twisting force is taken up by the frame of the tool.

Ordinary pliers rely on the strength of the pivot to prevent twisting of the blades and usually this design fails after a period of use.

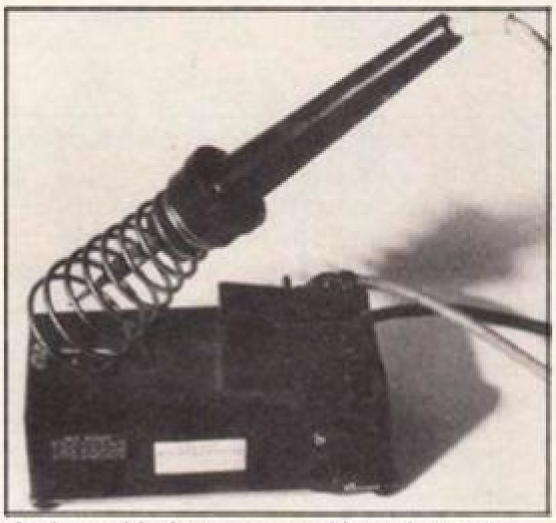
A good-quality multimeter is another essential tool. Analogue meters are suitable for the great majority of work on computers and are still inexpensive in comparison to their digital equivalents. Think about the measurement ranges that you will need — an average microcomputer may draw between two and three Amps from the +5 Volt power supply.

You will need the capability to check mains Volts around power supply units, PSUs, and the meter should have a 1,000Volt AC range. The meter should be able to measure resistance on several ranges and a low-power continuity tester with an audible output is also useful. One meter which is particularly good value for money is the Russian multimeter offered by Z & I Aero Services Ltd, 44a Westbourne Grove, London W2.

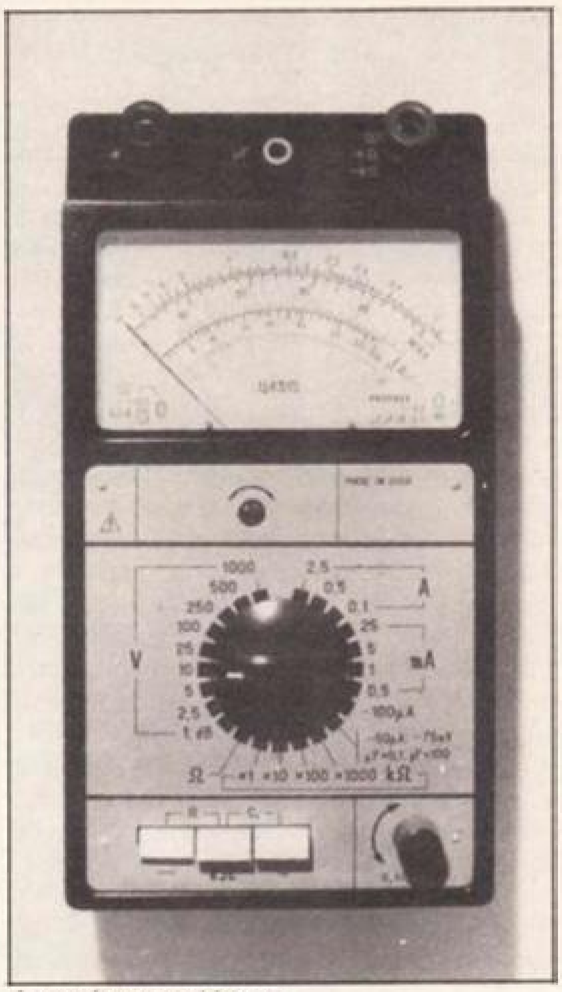
The 4315 version in the range uses a taut band suspension which seems almost impervious to physical shock and has a sufficiently high input resistance — 20,000 Ohms/Volt — not to disturb TTL circuits. The accuracy is 2.5percent of full-scale deflection, FSD, which is sufficient for work on microcomputers.



Forceps and wire insulation strippers.



An iron with thermostat and interchangeable bits is worth the cost.



An analogue multimeter.

Old wireless textbooks covered pages with descriptions of soldering techniques and all for circuits in which a 100 joints would be an above-average number. Today an average computer kit requires 1,000 or more soldered joints and a single "dry" joint can very nearly ruin the operation of the machine and be equally impossible to find.

It may, in fact, be easier to re-solder all the joints than to spend hours trying to identify the fault. So a good soldering technique is important; it is also not difficult to acquire.

The theory of soldering is to melt a lead/tin alloy around and in between two pieces of metal to fix them together and make an electrical connection. Many of the connections which have to be made in a microcomputer are very delicate. At the other extreme, the power-supply wiring may require something resembling a plumber's blow torch — one soldering iron is not adequate for both.

A thermostaticaly-controlled iron with an interchangeable pencil-shaped bit is ideal for work on printed-circuit boards, with a heavy-duty instant heat solder gun for power supply wiring and other big joints.

I use 22SWG solder for all my soldering and I think it is probably worthwhile paying the extra cost for solder containing a small amount of copper in the alloy. This reduces wear on the soldering iron and is said to produce a stronger joint.

Ordinary small irons have heating elements consuming about 20 Watts. A larger element which is always full on will raise the temperature of a small bit to a point where its life is shortened. The advantage of a thermostatically-controlled iron is that a 40- or 50-Watt element can be used giving a quick recovery from the drop in temperature when each joint is made. It ensures also that the bit is at the optimum temperature to make the solder flow into the joint quickly.

The best way to make a joint is to wet the tip of the iron with a little solder before applying the iron to the component lead and the PCB track. Heat the two metal parts to the right temperature quickly, apply the solder to the parts until it has flowed into the joint and formed a neat fillet, neither a convex blob nor an empty socket, and then remove the iron, allowing the joint to cool undisturbed.

It is worthwhile using a strong magnifying glass — ×5 to ×10 — for checking that joints are well made and, especially with IC sockets, that there are no solder bridges between tracks. High-quality kits have a solder-resist coating on top of the printed-circuit tracks. The Microtan 65 kit is typical and has a green resist which is perforated where each connection has to be made, reducing the possibility of inadvertently joining two tracks.

Using an iron at the proper temperature with a bit of appropriate size, a pre-tinned PCB and clean components, you should find that it takes about two to five seconds to solder each joint. LEDs, transistors and other semiconductors will not be damaged by heat transfer up the lead in this time and the routine use of a heat-sink is not necessary.

Spencer Wells artery forceps are a marvellous tool for holding a component in position and keeping it cool while it is soldered. They are also most useful for extracting components such as resistors from a board if you have put something in the wrong place.

Exact instructions for assembling the components will vary from kit to kit but the overall idea is simple. The most robust components should be soldered into the board first and it

(continued on next page)

Soldering Summary

Do invest in a soldering iron that will put a good amount of heat quickly into the joint.

Do make sure that component leads are clean — resistors in particular may have some oxide on the leads.

Do work in a well-lit and well-ventilated room. Polyurethane insulation on some wires can be a health hazard when it is heated and, similarly, the resin in cored solders is a known cause of asthma in some people.

Don't move or disturb a component while a joint is cooling. An intermittent connection or "dry" joint may be the result.

Don't keep the soldering iron on an ordinary component to PCB joint for longer than 10 seconds — if it has not soldered, something is wrong.

Don't check each joint immediately after you have made it. Particularly when you are doing a good deal of hand wiring, you should check the quality of the joints and that the joints are correct as far as the circuit is concerned after 12 or so connections. This allows you to look at the batch of connections more critically than when they are fresh in your mind.

(continued from previous page)

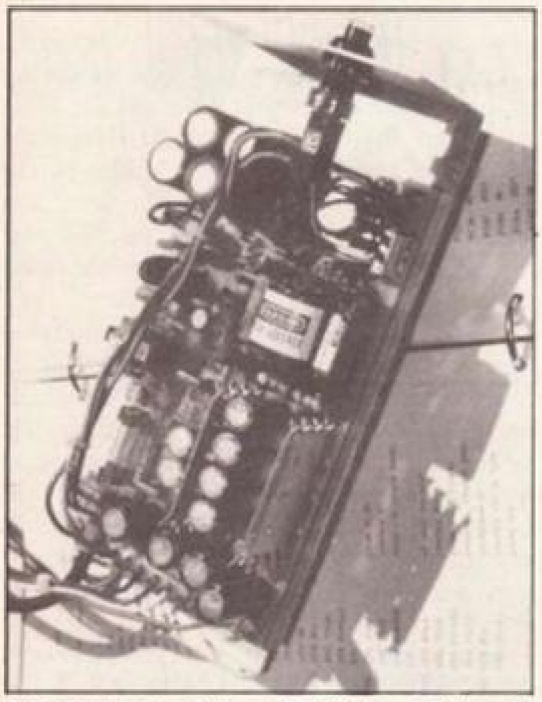
makes sense to deal with the shorter components first. A large capacitor, although robust in itself, may get in the way or be damaged by a great deal of handling if it is inserted at the beginning of construction.

The integrated-circuit sockets are a good start to the assembly process, particularly as they will account almost certainly for the majority of the soldered joints. Insert the 40-pin sockets first and then the next smaller size and so on. A smaller socket will fit into a larger set of holes and it is possible to make mistakes if you start with the eight- or 14-pin holders. The construction manual will probably advise you to solder in the resistors and capacitors next, followed perhaps by the semiconductors, transistors, diodes and LEDs.

The instructions with the kit may or may not contain colour identification for each resistor. The coloured bands on the body of the resistor are read according to table 3 and the value of the resistor can be calculated without trouble.

The value of a capacitor may be far more difficult to find. Some capacitors use coloured bands like resistors. Other codes may be difficult to read and illegible. If all else fails, look for a correspondence between the number of capacitors with the same label and the numbers quoted in the construction manual check-list. There should be some similarity between the component label and the circuit value, e.g., 1K and 1,000pF, 47K and .047μF.

Construct the power-supply unit, PSU, with care. There are no reports of ASCII messages



The compact switch-mode PSU supplied with the Microtan.

emanating from Ouija boards, so I presume you are not allowed to take it with you if you treat 240Volts AC with the same casual disregard you can give to +5 Volts.

One good rule for investigating any live circuit involving mains voltages is to keep one hand in your pocket so that there is a smaller chance of a shock straight across your heart. Better still — turn off the power before doing anything to modify the hardware.

Before you switch on, check. You almost have a collection of expensive silicon delicately poised to carry out your electronic wishes — do not hurry. Check that there are no stray wires or cut-off ends of component leads on your

Table 2

Non-essential tools

Oscilloscope
Spencer Wells artery forceps
IC test clip
Solder gun
Component-bending jig

Basic metal working tools

Ruler
Square
Sheet-metal cutters
Drill and drills
Hacksaw
Flat, half-round and rat-tail files

bench-top which may short the PCB when you apply power for the first time.

Complete the power-supply unit and connect it to the main-kit PCB before you insert the integrated circuits into their sockets. By doing this you can switch on the power supply and check all the supply voltages on the main board before destroying a set of expensive ICs. This procedure is also a first check for solder bridges from the PCB track to another.

If the power supply worked on its own but shows no Volts when connected to the board, there is probably a short circuit in either the wiring or a smoothing capacitor. If the kit contains tantalum electrolytic capacitors, check these first to see if any one of them is hot.

If you measure the correct voltages on the power-supply lines on the main PCB — turn-off and insert the integrated circuits. Before turning the computer on, check again that the ICs are inserted with the identifying notches correctly orientated.

The Microtan 65 is the single-board start of an expandable microcomputer designed and marketed by Tangerine Computers at Forehill in Cambridge. The basic kit costs about £80, excluding a power supply, and can be extended to a powerful floppy-disc-based system at whatever rate the user can afford.

The kit arrived promptly and was well packed. The documentation supplied with the kit is first rate — easy to read and understand, thorough and presented in a strong, sensible ring binder. Tangerine says in the Microtan manual that details of the RAM and ROM are of little concern to the user but I was surprised to find no circuit diagram of the Microtan in the information supplied with the kit.

When I telephoned Tangerine, I was told that the second issue of the printed-circuit board, with some circuit changes, was out of synchronisation with the new documentation, which was arriving from the printers. Circuit diagrams would be distributed and are a standard part of the manual.

It is worth emphasising that the use of the kit is supported profusely with details of all the output connections from the Microtan 65 board as well as the VIA chips on the Tanex expansion board. The point that Tangerine is making about the RAM and ROM is that most people are unconcerned, for example, about the intimate details of how the two clock signals are produced and I think that approach is reasonable.

Two resistors were missing from the kit and rather than wait for replacements, I substituted components of a different value — 18K instead of 10K. Had I had a circuit diagram, I might have been less worried when I switched on, but it did not matter and the Microtan worked immediately — a minor tribute to good engineering.

The construction manual said that there were two links on the Tanex board but I found three on the second issue board supplied. The Microsoft Basic and cassette-handling routines in X-BUG would not work until I had cut one more link than the manual instructed me to — documentation a little out of phase again, I presume.

A pre-assembled, switch-mode power supply was provided and the signs warning of high voltages emphasise that on this sort of power supply, there are more exposed parts than usual

Table 3

Colour code

Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Purple	7
Grey	8
White	9
Silver	10 percent tolerance
Gold	5 percent tolerance

Examples

Red Red Yellow	220,000 Ohms = 220 KOhms
Yellow Purple Brown Silver	470 Ohms 10 percent tolerance
Brown Grey Orange Gold	18,000 Ohms = 18 KOhms 5 percent tolerance

at mains potential. The unit will eventually be enclosed within a case but it reinforces the maxim — switch off before doing anything to the power supply or the computer.

Overall, the Microtan boards are well marked and I had no difficulty in locating the ICs or other components. As a rough guide to the time involved in building the kit, the central processor unit board took about five hours to build and was easy to put together; the Tanex has a higher packing density but was also easy to build, taking about three to four hours.

The performance of the system will be reviewed later this year but as far as the construction is concerned, the Microtan is strongly recommended as a well-organised, easy-to-build and coherently-thought-out basis for a powerful system.

The minor discrepancies I have noted in the manuals supplied with the kit should be seen in perspective; the hardware and software information is comprehensive, written in an English which is lucid and precise, and compares very well to the best professional standards.

Technical help is available from Tangerine engineers during normal working hours by telephone and the firm offers a repair service which has a target turnaround time of one week. ■

"In fact, because of its advanced capabilities, it can even be called a personal computing system". Five years ago, this admittedly provocative advertising statement might have heralded a new desk-top micro-computer. Few people, though, would have predicted it describing one of the latest generation of pocket programmable calculators, PPCs.

Until recently, programmables have used keystrokes stored as coded binary — BCD, see Jargon — in memory as program steps, a procedure similar to assembly language programming. Six months ago, Sharp introduced the PC-1211 Pocket Computer, similar in volume to other PPCs and yet programmable in Basic.

The kind of progress made was brought home to me recently when I tried to program a 10-year-old desk-top electronic calculator. This titanic of the computing world was a marvel of its time with 51 registers — see Jargon — 500 program steps and alpha-numeric — see Jargon — ability.

Yet my program to calculate the number of beers owed to whom in a group of six people took more than half the sluggish program memory. Before my dinosaur friend had crunched its last digit, I was well on the way to finding a quicker answer on an affluent friend's PC-1211.

This increase in sophistication has made calculators even more fun for those adventurous souls whose interest starts where most standard handbooks finish. For instance, take a non-programmable HP-45 and turn it on. The usual two decimal place 0.00 will appear. Press RCL — recall button — and then simultaneously the three keys CHS, 7 and 8. This admittedly unexpected combination produces an equally unexpected result.

Four groups of twin zeros appear on the display. Press CHS and the rightmost pair fly into action, counting at an alarming rate. We appear to have a clock on display registering hours, minutes, seconds and 100ths of seconds. Definitely not in the handbook.

Press CHS to stop/start timing and enter ↑ to return to normality. Somehow we have accepted into the X-Register — display register — of the calculator a display constantly updated by the oscillator clock essential to the operation of the microprocessor-based arithmetic unit.

So, the insides of the calculator were sufficiently complex to make it virtually impossible for design engineers to produce a surprise-free system. Most PPCs have a good few of these chinks in their armour.

Apparently much more goes on under the surface of a calculator than even the design engineers are willing to admit. Listen on a radio receiver to the flurry of activity as the microprocessor scans the keys for input. The key to many interesting new features lies in the generation of non-normalised numbers, NNNs, in data memory as opposed to the conventional binary-coded decimal — see Jargon.

An NNN is generally a 14-digit Hexadecimal-Base 16-number stored as binary code in a single register in a similar fashion to normal numbers. The trick lies in deceiving the calculator into storing program lines — which contain the decoded NNN — in data memory.

This procedure is easier with calculators which have partitionable program and data memories. I will talk more about the implications of NNNs in future issues. Think in the meantime of what may happen when an NNN is recalled to the display register or recorded on a printer. Normal numbers may be thought of as binary-coded decimal which specifies the full character set of the calculator.

If it is possible, through some design oversight, to score a coded word in a register which is not decimal, i.e., base 10, but Hexadecimal, i.e., base 16, then recalling this word to the display may have interesting effects. Also, programmables with tone functions can have the number of available tones increased by a factor of 10 by this method. Generally, the original Hex code has to be generated on a magnetic card.

There has been a printer system, for a calculator which will remain nameless, which would burn out on receiving the command to print a given NNN. It was possible to program it to self-destruct after turning on.

I always find a perverse sense of fun in programming a complex instrument like a calculator to perform totally frivolous functions. One of the best contenders for the Useless Program Of The Year Award is the one which converts Arabic numerals to Roman ones. All that is needed is an alpha-numeric programmable.

```
01•LBL "RN"
02 FIX 0          } 02 no roman fractions
03 1.01401        )
04 STO 27         ) Control statements for
05 14.02601       ) loop commands 24 & 25
06 STO 28         )
07 CLX
08 "DEC NUM=?"    )
09 AVIEW          ) Enter any integer between
10 STOP           ) 0 & 4000. Re-start with R/S.
11 PRX
12 STO 29
13 CLA
14•LBL 01
15 RCL 29
16 RCL IND 27     } Indirect recall of register
                    Numbered by ISG 27
17 -
18 X<0?
19 GTO 00
20 STO 29
21 ARCL IND 28
22 GTO 01
23•LBL 00
24 ISG 27
25 ISG 28
26 GTO 01
27 AON            )
28 AVIEW          ) Leaves machine in numeric
29 AOFF           ) mode displaying roman letters
30 STOP
31 END
R00= 1,000.
R01= 1,000.
R02= 900.
R03= 500.
R04= 400.
R05= 100.
R06= 90.
R07= 50.
R08= 40.
R09= 10.
R10= 9.
R11= 5.
R12= 4.
R13= 1.
R14= "M"
R15= "CM"
R16= "D"
R17= "CD"
R18= "C"
R19= "XC"
R20= "L"
R21= "XL"
R22= "X"
R23= "IX"
R24= "V"
R25= "IV"
R26= "I"
```

Here is an appropriate version for an HP-XLI C(V). Load the data registers as shown using STO & ASTO commands and then XEQ "RN".

Incidentally, Hewlett-Packard has announced a more powerful big brother to the 41-C, the HP41C-V, which has a capacity of 2,000 program units without any plug-in memory modules. This leaves all four module ports free for the use of peripherals.

I've often found it annoying with full memory capacity on the 41-C that no peripherals could be utilised. The new version retails at roughly the old price of the 41-C which now costs £30 less than before. I can already hear the groans from present 41-C owners.

Apart from on-board memory size, the two machines are identical. It will also be possible to upgrade a 41-C with the new plug-in quad memory module which will boost memory to 2,000 steps while leaving three ports free.

I hope the Jargon table helps you. Computing has spawned an outrageous number of baffling, and sometimes unnecessary, words and abbreviations. Maybe *Your Computer* can soften the blow.

In future issues, I hope to cover the latest calculator news, introduce some time-saving program hints involving the use of flags, etc., and to slightly alter the bias to Hewlett-Packard calculators which you probably have detected, especially if you are not a Hewlett-Packard user. Please send suggestions for the *Fingertips* column or contributions, e.g., amusing/interesting programs.

To end with, I have a competition to see how snappy a programmer you really are. An interesting if long-winded way of deriving square roots is the Newton-Raphson iteration technique, co-founded by Sir Isaac himself. The idea is to make a very rough order of magnitude guess of the root and to use the iterative procedure:

$$\text{New guess} = \tfrac{1}{2}\left(\frac{\text{number to be rooted}}{\text{old guess}} + \text{old guess}\right)$$

In almost all cases, the procedure will converge quickly to our square root. Let the criterion for stopping the procedure be when the value of

$$|(\text{New guess})^2 - \text{original number}| \leq \text{some number } E$$

I am going to award £5 of my own hard-earned pay as well as print in this column the most elegant/fast calculator program to solve this problem for the square root of 231 with first guess of 12.0 and E = 0.000001. The type of calculator will be taken into consideration.

This apparently naïve equation has a firm theoretical background and a more accurate second-order version of the technique is used in evaluation the gain of single-step amplifiers in electronic design.

DAVID PRINGLE ■

JARGON

■Binary-coded decimal — BCD:
Any decimal digit may be expressed in binary form — 0_{10}-9_{10} = 0000_2-1001_2 — i.e., four digits or bits inside a digital memory. If you like, the code is the Basic language of electronic calculators and defines all the key-stroke operations, numbers and addresses or locations of every piece of memory.

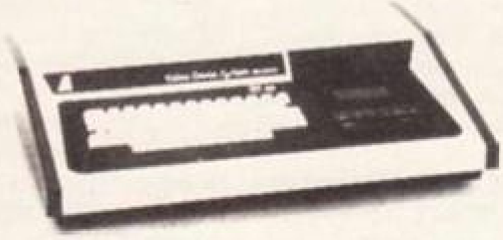
■Register:
Generally a piece of memory, located by its binary-coded address, capable of holding a floating-point number, its sign and a two-digit exponent and its sign. Most calculators work to 12-figure accuracy — Hewlett-Packards only to 10 — while displaying 10 or eight figures. At four bits per figure or sign, this means 64 bits or BCD — eight bytes — per register. Hewlett-Packard will only have seven-byte registers. In the latest calculators, the dividing line between data registers and program memory may be partitioned according to the user's personal quirks. Four registers are essential for holding intermediate results while performing display calculations with reverse Polish, a fully algebraic logic.

■Alpha-numeric code:
Binary code of the set containing numerals and letters of the alphabet.

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ZX-80

Crossword challenge

Colin Hogben,
Folkestone, Kent.

CROSSWORD allows you to produce a crossword grid and then fill in the answers without having to touch the newspaper and cover your fingers in ink. Unfortunately, the electricity used tends to outweigh the saving in biros, and you cannot use it on the train to work. On the other hand, you can have a bash at a prize crossword without worrying about making a mistake — you can write the correct answer over the wrong one.

The first input requested is the size of the grid; common sizes are 13 and 15, but there is space on the 1K ZX-80 for up to 17. Each line of the grid is entered as a string of zeros and ones, for empty and blacked-out boxes respectively.

The cursor is controlled by keys 5, 6, 7 and 8. For example, typing 88666 Newline moves the cursor two spaces to the right and down three. To enter a word in the grid, type EA or ED for across or down clues respectively; a pointer will appear, then type the word.

```
1 REM CROSSWORD
10 INPUT D
20 FOR N=1 TO D
30 INPUT A$
40 FOR P=1 TO D
50 PRINT CHR$(9*(CODE(A$)-28));
60 LET A$=TL$(A$)
70 NEXT P
80 PRINT
90 NEXT N
100 LET B=0
110 LET N=1
120 GOSUB 500
130 LET B=PEEK(N+P)
140 GOSUB 500
150 POKE N+P,19
160 INPUT A$
170 LET M=N
180 LET C=CODE(A$)
190 IF C=42 THEN GOTO 310
200 IF C=33 THEN LET M=M-1
210 IF C=34 THEN LET M=M+D+1
220 IF C=35 THEN LET M=M-D-1
230 IF C=36 THEN LET M=M+1
240 LET A$=TL$(A$)
250 IF NOT A$="" THEN GOTO 180
260 GOSUB 500
270 POKE N+B,B
280 LET N=M
290 LET B=PEEK(N+P)
300 GOTO 150
310 LET C=1
320 IF CODE(TL$(A$))=41 THEN C=D+1
330 GOSUB 500
340 POKE N+P,((C-1)/D)*36+151
350 INPUT A$
360 LET M=N
370 LET B=CODE(A$)
380 LET A$=TL$(A$)
390 LET M=M+C
400 IF A$="" THEN GOTO 140
410 GOSUB 500
420 POKE M+P,CODE(A$)
430 GOTO 380
500 LET P=PEEK(16396)+256*PEEK(16397)
510 RETURN
```

Reaction timer

Andy Hope,
Cheltenham, Gloucestershire.

TO RETURN TO the infamous cassette interface problems, I found that the temperature of the regulator had an adverse effect on the ability to load.

Rather than add insulators, I took things one step further by removing the regulator from the PCB altogether and mounting it in a separate metal box — thereby also giving it better heat-sinking. This has given me a greatly-increased load reliability.

The reaction-test program was developed from the program in the ZX-80 manual. It will fit into 1K machines and is self-explanatory.

```
10 REM REACTION TIMER
20 LET G=0
30 LET BEST =32000
40 LET TRY=1
50 CLS
60 LET G=G+1
70 FOR D=1 TO 20+RND(100)
80 NEXT D
90 PRINT
100 GOSUB 410
120 PRINT "HIT NEWLINE"
130 PRINT
140 GOSUB 410
150 POKE 16414,0
160 POKE 16415,0
170 INPUT R$
180 LET TIME=((PEEK(16415)*256)+(PEEK(16414)-4))*20
190 IF TIME<BEST THEN LET TRY=G
200 IF TIME<BEST THEN LET BEST=TIME
210 CLS
220 IF TIME<1000 THEN GOTO 250
230 PRINT "ssWAKE UP YOU DOZY ARTICLE":CHR$(136):CHR$(136)
240 PRINT
250 PRINT "REACTION TIME WAS":TIME:"M/SEC"
260 PRINT
270 IF G<2 THEN GOTO 360
280 PRINT "YOUR BEST EFFORT SO FAR WAS"
290 PRINT
300 PRINT "ATTEMPT NO ":TRY
310 PRINT
320 PRINT "WITH A REACTION TIME IF"
330 PRINT
340 PRINT "  ":BEST:"M/SECS"
350 PRINT
360 PRINT
370 PRINT "NEWLINE FOR NEXT ATTEMPT"
380 INPUT N$
390 IF N$="" THEN GOTO 50
400 STOP
410 FOR S=1 TO 10
420 PRINT "dar";
430 NEXT S
440 PRINT "af"
450 RETURN
```

Bar-graph plotter

Peter Collingridge,
Wiveliscombe, Somerset.

THE PROGRAM draws simple bar graphs but with a difference — the bars are drawn vertically, not horizontally as with other programs.

The program can easily be adapted and built on although the display takes a reasonably large amount of memory space. Because each line on the screen contains 32 characters, the program is ideal for drawing graphs over a period of one month, i.e., temperature or rainfall.

When run, the computer asks for 31 numbers, one at a time and numbers each

(continued on next page)

(continued from previous page)

one so that the operator can see easily what he is doing. The numbers are then stored in an array. The input values are the "heights" of each bar.

The program as shown will print up to a maximum of 15 but higher values than this will not affect the program.

Line 100 prints a space at the beginning of every line and this can be replaced by any other character. Lines 120-140 compare each element to a number from 15 down to one and then print the required symbol. @ represents shift A.

Lines 170-190 draw a base to the graph. After inputting all 31 values, the program takes about 10 seconds to draw the graph.

```
10 DIM A(31)
20 FOR B=1 TO 31
30 PRINT B;"-";
40 INPUT X
50 PRINT X;"   ";
60 LET A(B) =X
70 NEXT B
80 CLS
90 FOR C=1 TO 15
100 PRINT " ";
110 FOR D= 1 TO 31
120 IF A(D) > (16-C) THEN PRINT "@";
130 IF A(D) = (16-C) THEN PRINT "@";
140 IF A(D) < (16-C) THEN PRINT "@";
150 NEXT D
160 NEXT C
170 FOR C=1 TO 32
180 PRINT CHR$(131);
190 NEXT C
```

White-dot destroyer

R J Price,
Chelmsford, Essex.

THE GAME memory maps the screen in a 10-by-20 matrix and prints out white dots in a random pattern on to the screen. On pressing newline in the first input, the clock is set to 0. When you enter newline in the second input a white beam is Poked on to the screen according to the time elapsed.

The time which elapses between hitting newline for the first time and the second time must not exceed about seven seconds otherwise the player will run out of time.

The idea of the game is to destroy all the white dots within 15 turns. If all the dots are destroyed before the time is up, the hit should be entered into the first input. The screen is then Peeked for any characters and if there is none, the player has won.

```
1 LET J=0
5 LET C=0132
20 LET W=0
30 FOR A=1 TO 10
35 FOR B=1 TO 20
40 PRINT CHR$(128);
50 NEXT B
65 PRINT
67 NEXT A
70 RANDOMISE
80 FOR B=RND(4)+5 TO RND(6)+10
90 LET A=RND(7)+1
95 GOSUB 500
100 NEXT B
190 LET B=0
195 FOR K=1 TO 15
198 INPUTC$
200 IF B=0 THEN GOTO 210
201 FOR A=V TO 10
202 LET C=128
203 GOSUB 500
204 NEXT A
205 IF C$="HIT" THEN GOTO 900
210 POKE 16414,0
220 POKE 16415,0
227 PRINT K;" ";
230 INPUT C$
240 LET B=(PEEK(16414)+PEEK(16415)*256-4)/10
250 IF B>20 THEN GOTO 400
260 LET C=0
270 LET V=RND(3)+1
280 FOR A=V TO 10
290 GOSUB 500
300 NEXT A
310 NEXT K
400 PRINT"T I M E O U T"
410 STOP
500 IF A>10 OR B>20 THEN GOTO 400
510 LET P=PEEK(16397)
515 IF P>127 THEN LET P=P-256
520 LET W=PEEK(16396)+P*256
530 LET Y=(A-1)*21+B
535 IF J=1 THEN RETURN
540 POKE W+Y,C
550 RETURN
900 LET J=1
910 FOR A=1 TO 10
920 FOR B=1 TO 20
930 GOSUB 500
940 IF PEEK(W+Y)=128 THEN GOTO 960
950 GOTO400
960 NEXT B
970 NEXT A
975 PRINT"W E L L D O N E"
```

Polynomial solver

Paul Duckett,
Hassocks, West Sussex.

HERE IS a program which uses Newton's approximation to solve polynomials within the arithmetic limits of the ZX-80. Line 1 should be input with a space as the first character after REM, and the reverse video Z then inserted by the command Poke 16427,191.

The program solves equations of the form

$a_nx^n + a_{n-1}x^{n-1} + \ldots + a_1x + a_0 = 0,$

where n is less than 15 and each coefficient may be positive, negative or zero.

Inputs are self-explanatory. The value inserted for Guess is not vital — any value will find a real root in the machine's range if there is one — but if there is more than one root within the range, the Guess should be nearest to the root which you wish to find more exactly.

In line 10, A(1) to A(P+1) contain the coefficients of x^0 to x^P in the function whose roots are being found. In line 13, A(P+2) to A(2*P+1) contain the coefficients of x^0 to x^{P-1} in the derivative or slope of the function whose roots are being found.

Lines 30 to 33 find the value of the function and its slope for the current approximation to the root. Lines 35 to 37 try a new value for this approximation if the slope is 0. If the slope is not 0, line 38 calculates a closer approximation to the root.

When the new approximation is the same as the last one, line 39, the program computes the values of the function, V and W, for the two adjacent integers above and below the exact root — lines 56 to 64, with one or two passes of lines 26 to 34. These values are then used in line 66 to produce one decimal place of the root by linear interpolation.

There is a two-stage check for arithmetic overload before it occurs. Line 42 checks that the current approximation can be raised to the highest power in the function, and if it can be, lines 43 to 48 check that each power of x can be multiplied by its two coefficients before the attempt is made.

If overload would occur, the current approximation is moved 1 in the correct direction, line 53, and that new approximation checked for arithmetic overload. If overload would still occur the program stops at line 74.

The use of Q in lines 19, 26 and 27 stops a fruitless search for non-real roots. Line 65 prevents a spurious solution being "found" where the slope of a function not intersecting the x axis is very great at a "solution" tried by the program.

Although the linear interpolation may give errors of up to 1 for the higher powers, solutions found by the program are accurate for smaller powers. Integer roots are found exactly. Occasional difficulty with functions barely cutting the x axis can usually be remedied by entering a less-wild Guess.

```
1 REM (Z)D))($$&&&&&
3 PRINT "TOP POWER OF X?"
4 INPUT P
5 CLS
6 DIM A(2*P+2)
8 FOR C=1 TO P+1
9 PRINT "COEFFICIENT OF X**";C-1;"?"
10 INPUT A(C)
11 CLS
12 IF C=1 THEN GOTO 14
13 LET A(P+C)=(C-1)*A(C)
14 NEXT C
```

```
15 LET X=0
16 LET J=0
17 PRINT "GUESES?"
18 INPUT G
19 LET Q=0
20 CLS
26 IF Q=20 THEN GOTO 75
27 LET Q=Q+1
28 LET V=0
29 LET S=0
30 FOR D=0 TO P
31 LET V=V+A(D+1)*G**D
32 LET S=S+A(P+D+2)*G**D
33 NEXT D
34 IF X>0 THEN GOTO 74-9*X
35 IF NOT S=0 THEN GOTO 38
36 LET G=G+1
37 GOTO26
38 LET A=G-V/S
39 IF A=G THEN GOTO 56
40 LET B=ABS(A)
42 IF B>PEEK(16425+P)-10 THEN GOTO 52
43 FOR E=1 TO P
44 FOR L=0 TO 1
45 IF A(E+L*(P+1))=0 THEN GOTO 47
46 IF ABS(B**(E-1))>ABS(32767/A(E+L*(P+1))) THEN GOTO 52
47 NEXT L
48 NEXT E
49 LET G=A
50 LET J=0
51 GOTO 26
52 IF J=1 THEN GOTO 73
53 LET G=A-ABS(V/S)/(V/S)
54 LET J=1
55 GOTO 40
56 IF V=0 THEN GOTO 58
57 IF S/V>0 THEN GOTO 62
58 LET G=G+1
59 LET W=V
60 LET X=1
61 GOTO 26
62 LET G=G-1
63 LET X=2
64 GOTO26
65 IF V>0 AND W>0 OR V<0 AND W<0 THEN GOTO 75
66 LET M=10*ABS(W)/ABS(W)+ABS(V))
67 IF G<1 THENLET M=M+9
68 PRINT "ROOT=":CHR$((G=0)*18):G-1+M/10:
69 IF G<1 THEN LET M=19-M
70 IF M=10 THEN LET M=0
71 PRINT ".":M
72 STOP
73 PRINT "ROOT TOO BIG"
74 STOP
75 PRINT "ROOT NOT REAL"
```

ATOM

Graphics search

Allison Brown,
Grimsby, South Humberside

WHEN CONVERTING games programs to run on the Acorn Atom the following program will show you which number to 'poke' for a particular graphics symbol.

When running the program, all the Atom graphics will be displayed on the centre of the screen, one per second. The program can be ESC when the symbol you are seeking has appeared.

```
5 P.$12
10 A=49:B=48:C=48
20 FOR N=1 TO 255
30 PRINT#8110=N:PRINT#810D=A
40 FOR Z=1 TO 59:WAIT:NEXT Z
50 A=A+1
60 IF Z>57 A=48:GOS.A
70 IF A=57 B=B+1
80 IF B>57 B=48
85 IF A=48 AND B=48 GOS.B
90 NEXT N
100 E.
110 A PRINT#810 = B:RETURN
120 B C=C+1
130 PRINT#810B=C:RETURN
247 BYTES
```

Auto-run tape loader

Ian Pine,
Watford, Hertfordshire.

THE PROGRAM occupies the RAM associated with the I/O chip used by the monitor to communicate with the keyboard, display and tape interface. It is executed at 0E80 instead of the usual S command to save programs on to tape.

Three addresses are asked for, the first, prompted by "S", is the address at which the program is to be executed, and the other two are the "From" and "To" addresses respectively. After saving the program, control is returned to the monitor.

To retrieve a program from tape, the program is executed at 0EA8 instead of the usual L command. After loading, control is transferred to the user's program at the address specified.

```
0E80   A9 ED      LDA  £ED          0EA5   4C 6A FF   JMP  £FF6A
0E82   85 10      STA  £0010        0EA8   A2 01      LDX  £01
0E84   A2 02      LDX  £02          0EAA   20 DD FE   JSR  £FEDD
0E86   20 88 FE   JSR  £FE88        0EAD   95 02      STA  £0002,X
0E89   A9 F1      LDA  £F1          0EAF   CA         DEX
0E8B   85 10      STA  £0010        0EB0   10 F8      BPL  £0EAA
0E8D   A2 06      LDX  £06          0EB2   A2 04      LDX  £04
0E8F   20 88 FE   JSR  £FE88        0EB4   20 DD FE   JSR  £FEDD
0E92   A9 F8      LDA  £F8          0EB7   95 05      STA  £0005,X
0E94   85 10      STA  £0010        0EB9   CA         DEX
0E96   A2 08      LDX  £08          0EBA   D0 F8      BNE  £0EB4
0E98   20 88 FE   JSR  £FE88        0EBC   20 DD FE   JSR  £FEDD
0E9B   A2 01      LDX  £01          0EBF   81 06      STA  (£0006,X)
0E9D   B5 02      LDA  £0002,X      0EC1   8D 21 0E   STA  £0E21
0E9F   20 B1 FE   JSR  £FEB1        0EC4   20 A0 FE   JSR  £FEA0
0EA2   CA         DEX               0EC7   D0 F3      BNE  £0EBC
0EA3   10 F8      BPL  £0E9D        0EC9   6C 02 00   JMP  (£0002)
```

Cartoids drawing

Martyn Smith,
Shrewsbury, Shropshire.

THE PROGRAM draws a circle with imaginary numbered equi-distant gaps round it. Then it joins the numbered gap with its numbered multiple which you have to input. The program works for any number between —100 and 100 but numbers 1 to 10 work best.

Lines 5-90 prints what the program does. Line 100 puts screen into graphics mode 4. Lines 110-150 draws a circle. Lines 160-210 links up each number to its multiple. Lines 1000-1030 are a subroutine to work out co-ordinates of points round the circle.

Notes for conversion.

Lines 10-90; $=CHR$. ' = Carriage return. Lines 130, 140, 180, 200; MOVE X, Y = move graphics cursor to co-ordinates X, Y. Draw X, Y = draw a line to co-ordinates X,Y.

Lines 1000, 1020; % = the floating point value of. RAD = degrees to radians conversion.

The Program cartoids needs 6K of graphics memory and at least 1K of text.

```
5 REM PROGRAM TO DRAW CARTOIDS
10 PRINT $12
20 PRINT"      CARTOIDS"'
```

(continued on next page)

(continued from previous page)

30 PRINT" ____________ " '
40 PRINT" THIS PROGRAM DRAWS A CIRCLE" '
50 PRINT" THEN IT MARKS IT OUT IN IMAGINARY" '
60 PRINT" NUMBERED EQUI-DISTANT GAPS" '
70 PRINT" THEN IT JOINS ONE NUMBERED GAP" '
80 PRINT" TO ITS MULTIPLE IN MODULUS 360" '
90 INPUT" WHAT IS THE MULTIPLE" M
100 CLEAR 4
110 FOR I=0 to 360
120 A=1; GOSUB 1000
130 IF I=0 THEN MOVE X, Y
140 DRAW X,Y
150 NEXT
160 FOR I=0 to 360 STEP 4
170 A=I; GOSUB 1000
180 MOVE X, Y
190 A=IxM; GOSUB 1000
200 DRAW X, Y
210 NEXT
220 END
1000 %X = SIN(RAD(A))×95+96
1010 A=A+90
1020 %Y=SIN(RAD(A))x95+96
1030 X=%X; Y=%Y; RETURN

Atomic space battle

Christopher Histed, Chislehurst, Kent.

YOU ARE commanding the guns of a space cruiser in this real-time game. The aim of the game is to shoot down the alien space craft in the shortest time possible — using as few lasers as you can — to gain the highest score.

The aliens are depicted using the high-resolution graphics of the Acorn Atom. Here, the graphics are 128 dots along the X axis, and 192 dots along the Y axis, i.e., it uses clear 3.

The way that you shoot down the aliens is to manoeuvre your gunsights over the alien, and fire your laser cannon. The gunsights are shown as crosshairs on the screen, and these are moved about by pressing certain keys to indicate direction. These keys are:

to go up ↑
to go right ≡
to go down ↕
to go left ↔

Space to fire your laser cannon.

The aliens — which appear one at a time until they are all destroyed or you have run out of laser bombs — will move about slowly if no gunsight movement is made.

```
0003  B=0:F=0:O=0
0006  P.#12';INPUT" ALIENS "I
0007  INPUT" LASERS "L
0010  DIM K(2),KK(3);X=128/2;Y=192/2
0011  LET U=ABSRND%128;LET N=ABSRND%192
0020  FOR J=0 TO 1;DIM P(-1)
0030  [;:KK0 LDY @#3B;CLC;LDA @#20;:KK1 LDX @10;:KK2 BIT #B001;BEQ KK3
0040  INC #B000;DEY;DEX;BNE KK2;LSRA;:KK3 PHP;PHA
0045  LDA #B000;AND @#F0
0046  STA #B000;PLA;PLP;BNE KK1;STY K
0050  RTS;];NEXT J
0060  CLEAR 3
0070  LINK KK0
0071  GOSUB 799
0075  F=F+1
0080  IF ?K=7 GOTO 199
0090  IF ?K=6 GOTO 399
0100  IF ?K=29GOTO 499
0110  IF ?K=4 GOTO 299
0120  IF ?K=0 GOTO 599
0125  U=U+(RND%3);N=N+(RND%5);IF N<0 THEN N=0
0126  IF N>192 THEN N=192
0127  IF U<0 THEN U=0
0128  IF U>128 THEN U=128
0130  GOTO 70
0140  MOVE(X-15),Y;PLOT 7,(X+15),Y;MOVE X,(Y-20);PLOT 7,X,(Y+20)
0145  RETURN
0150  MOVE(X-15),Y;DRAW (X+15),Y;MOVE X,(Y-20);DRAW X,(Y+20)
0170  GOTO 70
0199  GOSUB 140;Y=Y-10;IF Y<0 THEN Y=0
0200  GOTO 150
0299  GOSUB 140;Y=Y+10;IF Y>192 THEN Y=192
0310  GOTO 150
0399  GOSUB 140;X=X-5;IF X<0 THEN X=0
0410  GOTO 150
0499  GOSUB 140;X=X+5;IF X>128 THEN X=128
0510  GOTO 150
0599  Q=Q+1;IF Q>L GOTO 900
0600  P.#7; FOR R=1 TO 15 STEP 2
0610  MOVE (X+R),0;DRAW X,Y;MOVE (115+R),0;DRAW X,Y;NEXT R;P.#7
0615  FOR R=1 TO 15 STEP 2
0620  MOVE (X+R),0;PLOT 7,X,Y;MOVE (115+R),0;PLOT 7,X,Y;NEXT R
0650  IF X> (U+3) GOTO 70
0651  IF X< (U-3) GOTO 70
0652  IF Y> (N+5) GOTO 70
0653  IF Y< (N-5) GOTO 70
0655  FOR C=1 TO 60;H=RND%30;V=RND%50;PLOT 13,(X+H),(V+Y)
0660  NEXT C
0665  FOR C=1 TO 100;WAIT;NEXT C
0666  U=ABSRND%128;N=ABSRND%192;B=B+1
0667  IF B<I GOTO 70
0670  P.#7" WELL DONE"'
0668  CLEAR 0
0680  P.F" TURNS TAKEN TO DESTROY THE ALIENS "
0681  P." YOUR FINAL SCORE WAS :"(100-(L-1)*(1000-F))
0690  GOTO 10000
0700  GOTO 70
0799  Z=13
0800  PLOT Z,U,N;PLOT Z,(U+1),(N+1);PLOT Z,(U+1),N
0801  PLOT Z,(U-1),N;PLOT Z,(U+1),N;PLOT Z,(U-2),(N-1)
0802  PLOT Z,(U-1),N;PLOT Z,(U+2),(N-2);PLOT Z,(U+3),(N-1)
0804  IF Z=15 GOTO 810
0805  Z=15; GOTO 800
0810  RETURN
0900  P.#12" ALL LASERS USED , YOU FAILED "
10000 END
```

Atom information

Derek Haslam, Colne, Lancashire.

THE ATOM manual makes it clear that the floating-point variables %@ to %Z are always stored in order from 2800_{16} upwards, each occupying a five-byte sequence. It seemed probable that the integer variables @-Z were stored in a similar way and examining the Basic workspace from 240_{16} to $3FF_{16}$ showed this to be nearly correct — but not quite.

In fact the 27 bytes from 321_{16} to $33B_{16}$ hold the low-order bytes of the integer variables. The second bytes occupy locations 33C-356, the third bytes 357-371 and the high-order bytes are to be found at 372-38C. Thus the variables may all be initialised to zero by the following lines:

```
10?#80=0
20 DO?#80=?#80+1
30?(#320+?#80)=0
40 UNTIL ?#80=108
50 END
```

For those unfamiliar with the Atom, #before a number signifies that the latter is a Hex number and a statement of the form

?A=?A+1

is equivalent to

POKE A, (PEEK(A)+1).

The program uses no named variables and the Do Until loop — which is such a useful feature of Atom Basic — is necessitated by the fact that only an integer variable may be the loop counter in the more usual For Next structure.

The fixed storage of simple numeric variables undoubtedly contributes to the speed of Atom Basic. As soon as the interpreter encounters a reference to A it knows exactly where to find or store the contents of A — there is no variable table to search. At the same time, it imposes a severe restriction on the range of variables allowed.

The addresses corresponding to the labels a-z to which Goto and Gosub statements may be directed are stored immediately after the variables at $38D_{16}$—$3C0_{16}$; two bytes for each.

Finally, a question. Can anyone tell me how to determine which key has been or better still is being pressed on the Atom?

Escapist solution

J Gordon, London W9

WHEN WORKING in Basic on my UK101 I have often found it a nuisance, especially with long programs, that the 21st command cannot be continued after a Break or after being momentarily stopped as with the Escape key. Therefore I wrote this small program to solve the problem.

UK101

```
0228 98       TYA         ;Save Y register
0229 48       PHA
022A AD00DFLDA $DF00      ;Check for shift
022D C9FA     CMP £$FA
022F D003     BNE $0234
0231 2000FD JSR $FD00     ;Input key
0234 68       PLA
0235 AB       TAY
0236 4C9BFF JMP $FF9B     ;Ctrl C routine
```

It checks to see if the Left Shift has been depressed and if so, waits until another key is hit. The Control-C vector is re-directed to 0228 Hex allowing the Escape check to be made before each Control-C.

In making it, I found one problem -- the Ctrl-C vectors cannot be changed by Poking in the correct numbers.

A warm start will cancel the Escape key. To make the job of restoring the Escape key easier, the following Hex code, should be entered via the monitor with each byte followed by a return.

0Z40/A9 28 8D IC 02 A9 02 8D 1D 02 4C 74 A2

Now all that is necessary is 0240G. ■

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HP-34C £83.43 210-program-step scientific calculator.
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TI-57 50 program steps.
TI-58 480 program steps. Plug-in library module.
TI-59 960 program steps. Plus-in library module.
PC-100C Printer for S8 and S9.

CASIO: 28 Scrutton Street, London EC2. 01-377 9087.
fx 501 £64.95 128 program steps.
fx 502 £84.95 256 program steps.

COMMODORE: 360 Euston Road, London NW1. 01-757 4111.
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A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in June. The name of the winner, the solution and a competition report will be published in the next issue of *Your Computer.*

If you want to set a competition for *Competition Corner,* remember that the simplest solution should be calculatable by a short program rather than by any other form of reckoning.

Bursting bubbles

BY ANTHONY ROBERTS

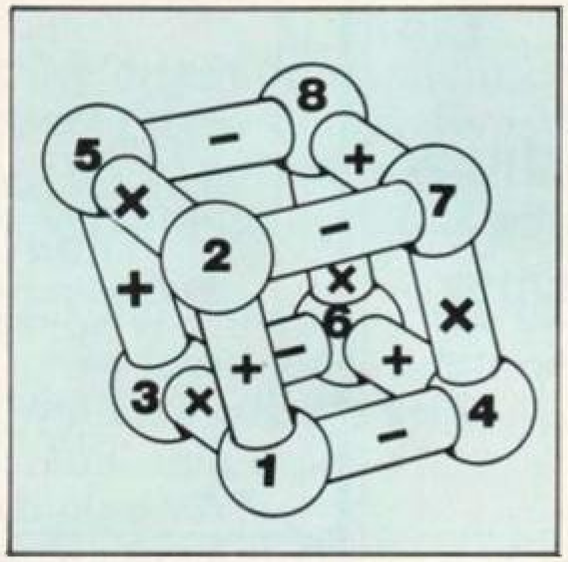
STUDENTS at the Old Swan Cybernetics and Robotics School, Oscars, have discovered an amazing alien life-form while investigating some samples of Moon-dust — microscopic, bio-logic, cellular structures consisting of minute bubble-memories, connected by tubes which act like the arithmetic operators +, -, x.

The problem in using these microbes is that the bubbles burst on releasing their stored number. So, for instance, in the specimen shown here — magnification X300,000 — the number 70 can be obtained in the final bubble by following the route

5+3x1+2-7+8x6+4=70.

What is the largest number that can be accumulated in this specimen? You may start anywhere and follow any route you please — there is no need to visit every bubble.

No employees of IPC Business Press or their relatives may enter the competition. The decision of the editor is final and no correspondence on the result of the competition will be entered into.



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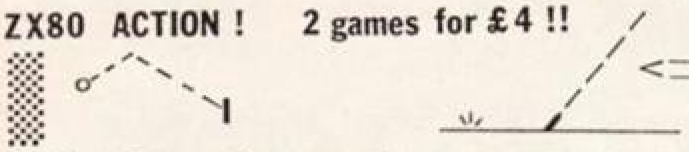
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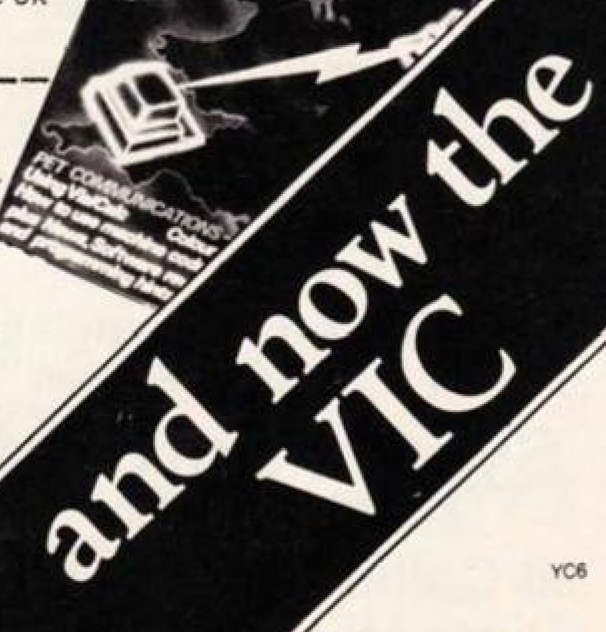
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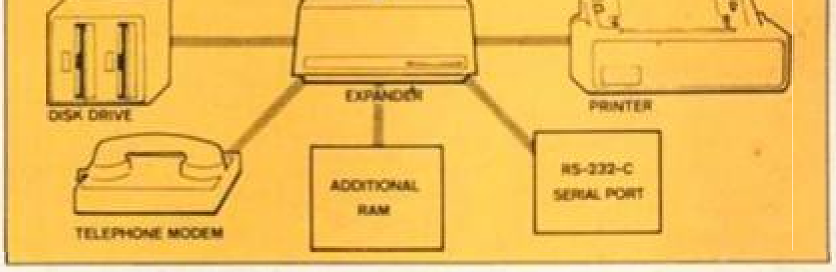
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